Preliminary Data Review and Source Assessment for PCB TMDL Development

Roanoke River Basin, Virginia

DRAFT

Prepared for
U.S. Environmental Protection Agency – Region III
Virginia Department of Environmental Quality
U.S. Fish and Wildlife Service

Prepared by
Tetra Tech, Inc.

February 4, 2005

Contents

1. Introduction

Virginia's 303(d) list includes several waterbodies in the Roanoke River Basin that were listed as impaired due to elevated Polychlorinated Biphenyl (PCB) concentrations that have been found in fish tissue and sediment samples. The Virginia Department of Environmental Quality (DEQ) first collected information on PCB levels in the Roanoke Basin in 1971. Fish tissue and sediment sampling for PCBs in the Roanoke Basin resumed in 1993 and a rotating basin monitoring schedule is currently ongoing as part of the Statewide Fish Tissue and Sediment monitoring program. The Virginia Department of Health (VDH) has issued fish consumption advisories for several sections of the Roanoke (Staunton) River and tributaries since 1998 based on the fish tissue data collected by DEQ.

Section 303(d) of the Clean Water Act requires states to develop Total Maximum Daily Loads (TMDLs) for waters that do not meet water quality standards. The objective of the Roanoke PCB TMDL study is to identify the sources of PCB contamination in the watershed and to determine the reductions required to achieve water quality standards for PCB impaired segments.

The impairment listings for stream and reservoir segments in the Roanoke Basin are based on the culmination of studies and data collected to date. TMDL development requires a complete review of existing data in order to assess data gaps and propose additional monitoring, as needed. This document presents a historical review of all available PCB data and source information related to the impaired segments included in this study. Fish Tissue data collected since 1993 is emphasized in this report due to differences in the analytical methods as compared to the older (1971) data.

A full accounting of PCB sources in the watershed is currently not available, therefore, additional monitoring will be necessary to identify the contributing sources of PCBs to these segments. A sampling plan will be developed over the next couple months that will include proposed sampling locations and parameters to facilitate PCB source identification and TMDL development. A Quality Assurance Program Plan (QAPP) will be developed concurrently to support additional PCB sampling and other TMDL monitoring activities in the watershed. TMDLs will be developed using an appropriate modeling framework in order to assess PCB sources in the watershed, determine impacts to water quality and aquatic life, and to establish the pollutant reductions necessary to meet water quality standards.

2. Background

2.1 PCB Characteristics

PCBs are a group of synthetic chemicals that consist of 209 individual compounds (known as congeners). Physically, they are either oily liquids or solids and are colorless to light yellow in color with no known smell or taste. PCBs made in the United States were marketed under the trade name Aroclor and most are identified by a four-digit numbering code in which the first two digits indicate that the parent molecule is a biphenyl. Each of the 209 possible PCB compounds consists of two phenyl groups and chlorine atoms (chlorination). Individual PCB congeners differ in the number and position of the chlorine atoms. PCBs possess excellent dielectric and flame resistant properties derived from the stable structure of their constituent congener mixtures. These same properties cause PCBs to accumulate in the fatty tissue of biota and bioaccumulate in the food chain. (http://www.epa.gov/ttn/atw/hlthef/polychlo.html).

Although it is now illegal to manufacture, distribute, or use PCBs, before 1974 these synthetic oils were used in capacitors, transformers, plasticizers, surface coatings, inks, adhesives, pesticide extenders, and carbonless duplicating paper. After 1974, PCB use was restricted to the production of capacitors and transformers, and in 1979 the manufacture and use of PCBs was completely banned. Historically, PCBs have been introduced into the environment through discharges from point sources and through spills and

releases. Although point source contributions are now controlled, historical nonpoint sources may exist. Once in a waterbody, PCBs become associated with sediment particles. PCBs are very resistant to breakdown and thus remain in river and lake sediments for many years.

2.2 Impairment Summary

In 1971 the Virginia State Water Control Board conducted a study to determine the extent of pesticides in the environment. Elevated PCBs concentration in fish tissue samples from the Roanoke and Dan Rivers were found and the results were published in a 1973 report.

Between 1979 and 1991, the VSWCB and the U.S. Environmental Protection Agency (EPA) conducted a variety of studies that included some additional monitoring of fish collected from the Roanoke River. Some of the fish samples indicated a persistent presence of PCBs in several areas of the Roanoke River. In late 1992, the Virginia Department of Health (VDH) recommended collecting additional fish in the Roanoke River to better characterize the extent of PCB contamination. An extensive fish tissue study was conducted by the VSWCB from February to August 1993 and a final report was issued June 1996. Elevated levels of PCBs were detected in fishes collected from several sites on the Roanoke River.

Additional sampling in the Roanoke River and Dan River was conducted in 1998 and 1999. Based on these data, the VDH issued health advisories for sections of the Roanoke and Dan Rivers where fish showed levels of PCBs greater than the VDH screening level of 600 ppb. The initial PCB fish consumption advisory was issued for the Roanoke (Staunton) River on 7/24/98. The advisory for this segment was modified on 3/26/99 to include three additional fish species. On 12/2/99 the fish consumption advisory was extended to include the 29-mile segment upstream to the Leesville Dam. The entire segment extends from Leesville Dam downstream to the Dan River confluence.

DEQ continued fish tissue sampling efforts in 2000 and 2002. These data resulted in the issuance of a fish consumption advisory for the Roanoke River from the Niagara Dam downstream to Smith Mountain Lake on 10/29/03. The VDH adopted new fish consumption advisory guidelines on 12/13/04 that include a "do not eat" PCB concentration threshold of 500 ppb and a limited consumption (not more than 2 meals/month) PCB concentration range between 50 and 500 ppb. These guidelines resulted in modifications to the existing Roanoke River fish consumption advisories and the issuance of an advisory for the Upper Roanoke River from the confluence of the North and South Forks of the Roanoke River (near the Lafayette gauging station) downstream to the Niagara dam. The Upper Roanoke advisory also includes Peters Creek upstream to the Rt. 460 bridge crossing and Tinker Creek upstream to the confluence with Deer Branch (near Rt. 115). In addition, Smith Mountain Lake from the Niagara dam downstream to Smith Mountain Dam and the Blackwater River arm upstream to the Rt. 122 bridge are included in the advisory area. The Dan River and Kerr Reservoir advisories were also updated on 12/13/04. Note that DEQ sampled the Roanoke River basin in 2004. These results will be available in the spring of 2005.

The current fish consumption advisories concern the following species:

- Roanoke River (all species – no more than 2 meals/month): Carp, Redbreast Sunfish, Redhorse Sucker, Smallmouth Bass, Largemouth Bass, Rock Bass, and Bluehead Chub.
- Smith Mountain Lake/Blackwater River section: Flathead Catfish greater than 32 inches – do not eat. All other species – No more than 2 meals/month: Flathead Catfish less than 32 inches, Striped Bass, Gizzard Shad, Redhorse Sucker, Largemouth Bass, and Carp.
- Roanoke (Staunton) River: Carp and Flathead Catfish greater than 32 inches – do not eat. All other species – No more than 2 meals/month: Flathead Catfish less than 32 inches, Gizzard Shad, Golden Redhorse Sucker, Striped Bass, Channel Catfish, Walleye, White Bass, Largemouth Bass,

Redhorse Sucker, Redbreast Sunfish, Smallmouth Bass, Quailback Carpsucker, Spotted Bass, White Perch, Bluehead Chub, Sunfish Species, Bluegill Sunfish, Rock Bass

Under a Memorandum of Understanding between DEQ and the VDH, all data generated by the Virginia Fish Tissue and Sediment Contaminants Monitoring Program are provided to the VDH as soon as possible after the data are received from the analytical lab. The VDH reviews the data and provides recommendation to DEQ regarding whether or not there is a potential for an unacceptable risk to human consumers and whether there is a need for follow-up tissue studies. The VDH is also responsible for deciding when there is a need for issuing a fish consumption advisory to the public regarding the potential risk associated with eating locally caught fish.

The collection of additional fish tissue and sediment data since 1993 has resulted in a growing list of river and lake segments that are considered impaired due to human health and aquatic life concerns. DEQ 2004 303(d) PCB impaired segments and the current VDH fish consumption advisory segments (issued on 12/13/04) along the Roanoke River mainstem are shown in Figure 2.1 and Table 2.1. The EPA scope of work for this project currently includes those segments that were listed on DEQ's 11/25/03 priority TMDL list (see shaded rows in Table 2.1). The upstream portion of Leesville Lake (Pigg River arm, 154 acres) was also included on DEQ's priority TMDL list. This waterbody was not listed for PCBs on Virginia's 2004 303(d) list.

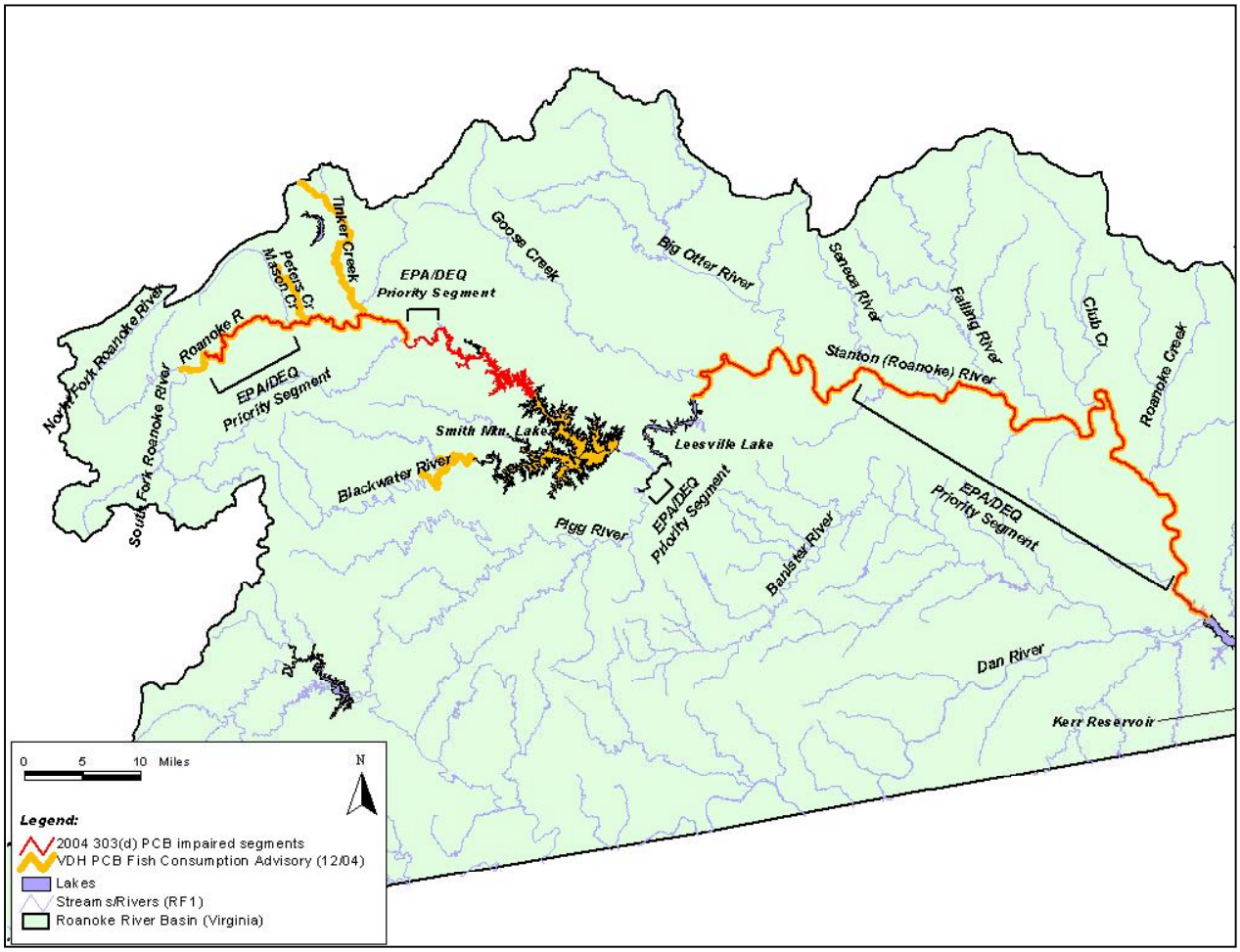

Figure 2.1 PCB impaired segments and fish consumption advisories (as of 12/13/04)

Table 2.1 PCB impaired segment descriptions and fish consumption advisories (as of 12/13/04)*

Water-body	Segment Description	County/ City	Miles/ Acres	Initial Listing	TMDL Due	VDH Advisory 12/13/04
Roanoke River	Near Dixie Caverns – Rt. 11 bridge near Rt. 419	Roanoke, Salem	11.68 miles (combined 2 segments from 2002)	2002	2014	Advisory extends upstream to the confluence of the North and South Forks of the Roanoke River
Roanoke River	Rt. 11 bridge near Rt. 419 – Mason Cr. confluence	Salem	1.2 miles	2002	2014	
Roanoke River	Mason Cr. confluence – Roanoke Regional STP outfall	Roanoke City, Salem	9.87 miles	1996 (PCBs 2002)	2006	Advisory includes Peters Creek (upstream to the Rt. 460 bridge) and Tinker Creek (upstream to the Rt. 122 bridge)
Roanoke River	Roanoke Regional STP outfall – Niagara Dam	Roanoke, Roanoke City	2.24 miles	1996 (PCBs 2002)	2006	
Roanoke River	Niagara Dam – Back Cr. mouth	Bedford, Roanoke	3.35 miles	2002	2006	
Smith Mtn. Lake	Back Cr. mouth – Falling Cr. mouth	Bedford, Franklin, Roanoke	378 acres	1998 (PCBs 2002)	2010	
Smith Mtn. Lake	Falling Cr. mouth – Upstream of Beckys Cr. mouth	Bedford, Franklin	2,871 acres	2002	2014	12/13/04 advisory includes the entire lake and the Blackwater arm upstream to the Rt. 122 bridge
Staunton (Roanoke) River	Leesville Dam – Pipeline crossing 5.4 miles downstream of Rt. 360 bridge	Charlotte, Halifax, Campbell, Pittsylvania	83.9 miles (combined several 2002 segments); 1998 upstream limit was Seneca Cr. mouth	1998	2010	
Staunton (Roanoke) River	Pipeline crossing 5.4 miles downstream of Rt. 360 bridge – Kerr Reservoir	Halifax, Charlotte	4.49 miles	1998	2010	

* 2004 303(d) segment information shown

2.3 Endangered Species Concerns

In addition to the human health concerns associated with environmental PCB exposure, there are concerns about the effects of PCB pollution on biota in the Roanoke River basin. The resident bald eagle population and the endangered Roanoke Logperch (*Percina rex*) have been identified by the Virginia Branch of the United States Fish and Wildlife Service (USFWS) as species that are potentially at risk from the effects of PCB contamination. The Roanoke Logperch is a federally endangered species that only occurs in the Upper Roanoke drainage, Pigg River, Smith River, and larger tributaries. The Orangefin Madtom (*Nocturus gilberti*) is also only found locally and is listed as threatened in Virginia and as a species of special concern nationally.

Bald eagles may also suffer from exposure to PCBs through eating fish that have high PCB levels (C. Kane, pers. comm. 2004). Bioaccumulation is the net accumulation of a substance by an organism as a result of uptake from all environmental sources (i.e. water and food consumption). PCBs ingestion has been found to correlate to various effects on birds including; poor reproduction, endocrine disruption behavior, altered embryonic development and death (Smits and Bartolotti, 2001; Fernie et al., 2001(a);

Fernine et al., 2001(b); Fernie et al., 2000; Ludwig et al., 1996). Embryos have been identified as the most sensitive developmental stage.

3. Watershed Characterization

The Roanoke River begins at the confluence of the North and South Forks located in Montgomery County, Virginia. From its headwaters, the Roanoke flows in an east-southwest direction through several large reservoirs including Smith Mountain Lake, Leesville Lake, and Kerr Reservoir before it crosses into North Carolina. The cities of Salem and Roanoke are located in the upper portion of the watershed and are the largest population centers. The watershed is predominantly rural, especially downstream of Smith Mountain Lake. Land use information for the Roanoke River Basin is shown in Figure 3.1.

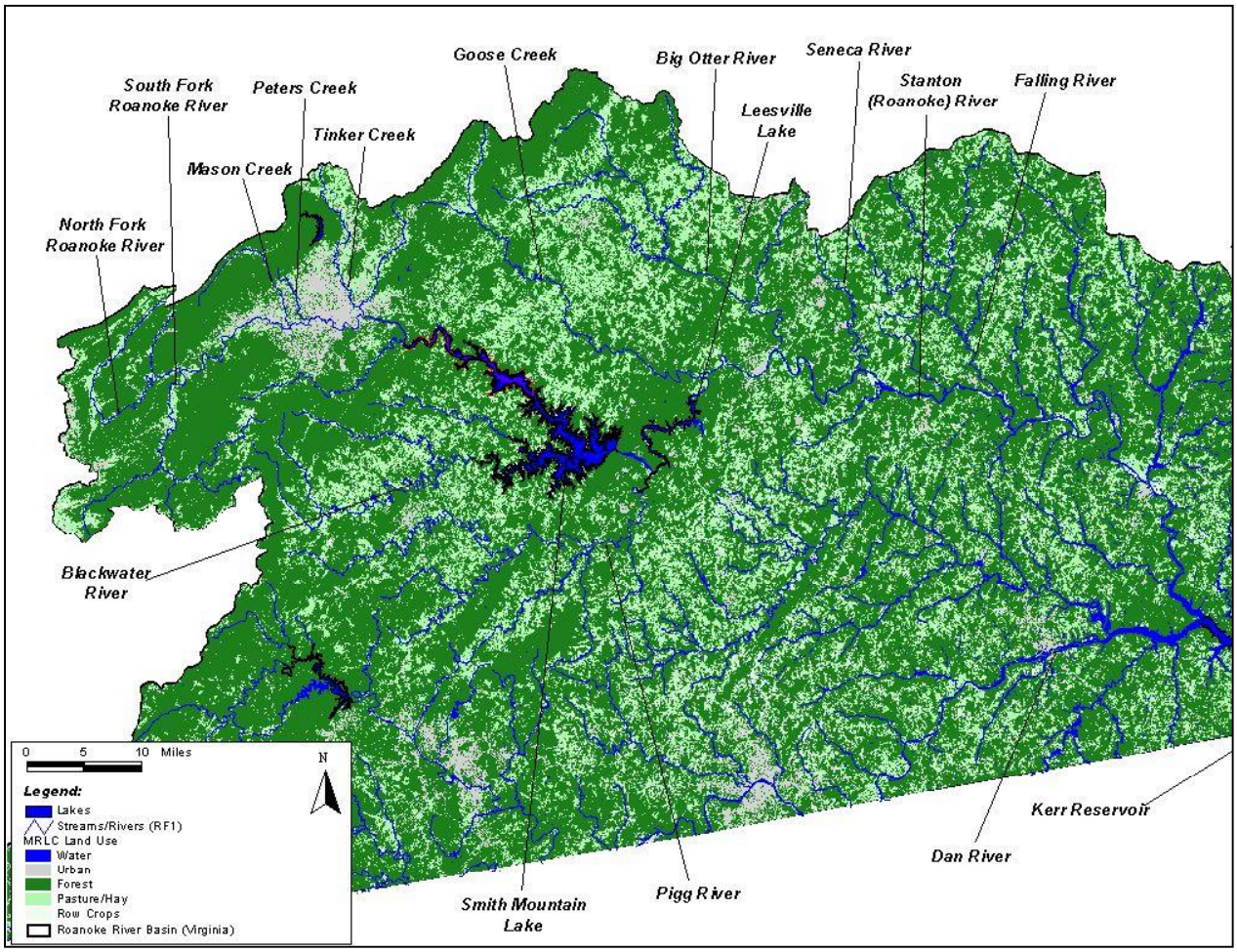

Figure 3.1 Land use in the Roanoke River Basin (MRLC 1992)

4. Data Summary

4.1 Past Studies

The following PCB data summary was developed based on a compilation of the fish tissue, sediment, and water quality samples collected and analyzed by DEQ since 1967. DEQ collected fish tissue samples from the Roanoke River and tributaries in 1971, 1993, 1998, 1999, 2000, 2002, and 2004. Sediment samples were collected from 1996 through 2000 and again in 2002. Fish tissue and sediment data collected in 2004 will be available in the spring of 2005. Fish tissue PCB data collected in 1971 and presented in the 1973 report, *The Occurrence of Polychlorinated Biphenyls in the Roanoke and Dan Rivers-A Preliminary Report*, are not included in this report because of differences in the analytical methods used. Table 4.1 presents the available PCB data sources for the Roanoke Basin.

Table 4.1 PCB data sources for the Roanoke River Basin

Dataset	DEQ Data Source	Period of Record	No. of Samples included in the referenced dataset	No. of Samples in Roanoke River Basin
PCB water column data	Parameter specific dataset submitted by DEQ	1967-2004	21889	21889
PCB fish tissue data	File: 1993-2002fish-pcb-ocp.xls	1993-2003	3162	1124
PCB sediment data	File: sediment-pcb1995-2002.xls	1995-2002	622	181
1973 VA State Water Control Board PCB Study of the Roanoke and Dan Rivers	DEQ report	1971		
PCB Concentrations in Fish Tissue Collected in the Roanoke and Dan Rivers: Summary of the Data from the 1998-1999 Studies and a Comparison with Historic Data	DEQ report	1971, 1998-1999		

4.2 PCB criteria

All waters in Virginia have the designated uses of contact recreation, propagation of fish and game, and production of edible and marketable natural resources such as fish (9 VAC 25-260-10). Virginia's water quality standards for PCBs include numeric criteria for individual PCB Aroclors for the protection of aquatic life and a total PCB criterion to protect human health from toxic effects through fish consumption. Both are expressed as water column concentrations. These numeric concentrations are based on criteria developed by EPA as issued in its 1999 Final Rule: *Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants; States' Compliance--Revision of Polychlorinated Biphenyls (PCBs) Criteria*.

The EPA criteria took into consideration cancer studies that strengthen the case that all PCBs mixtures can cause cancer. EPA used this information to develop a range of dose response slopes, changing the single-dose cancer potency factor of 7.7 per mg/kg-d to a range from 0.07 per mg/kg-d (lowest risk and persistence) to 2.0 per mg/kg-d (high risk and persistence). The reassessment uses information on environmental processes to provide guidance on choosing an appropriate slope for representative classes of environmental mixtures and different exposure pathways.
DEQ has also developed numeric criteria for total PCB levels in fish tissue based on EPA cancer risk assessment studies. DEQ uses a PCB screening value of 54 ppb for fish tissue, which is based on

information originally developed and published by EPA in 1993 and revised in 1995. Typical screening value calculations use the following assumptions: a 10-5 risk level adopted by the State Water Control Board; a human body weight of 70 kg (average adult body weight), a lifetime fish consumption rate of 6.5 g/d (general U.S. population), and a reference dose for non-carcinogenic and an oral dose slope for carcinogenic effects (EPA Integrated Risk Information System - IRIS database system). Fish containing a contaminant at or below the screening value concentration are considered to pose minimal risk to the average consumer. The VDH adopted new fish consumption advisory guidelines on 12/13/04 that include a "do not eat" PCB concentration threshold of 500 ppb and a limited consumption (not more than 2 meals/month) PCB concentration range between 50 and 500 ppb.

VADEQ currently uses a consensus-based sediment quality guideline (MacDonald et al.) known as a Probably Effects Concentration (PEC) for total PCBs (676 ppb) to assess sediment contamination. In spite of the uncertainty associated with sediment quality guidelines, this screening value is considered to be protective of aquatic organisms exposed to PCBs in the sediment.

The USFWS conducted a study in the summer of 2003 to determine the acceptable concentration of PCBs in bald eagle eggs and forage fish (C. Kane, pers. comm. 2004). The reported NOAEL (No Observed Adverse Effect Level) for bald eagles eggs was a total PCB concentration of 0.04 ug/g (wet weight). NOAEL is defined as the greatest concentration or amount of a chemical, found by experiment or observation, that causes no detectable adverse alteration of morphology, functional capacity, growth, development, or life span of the target (WHO 1979). Considering potential bioaccumulation in the food chain, the acceptable total PCB concentration in forage fish was calculated to be 0.004522 ug/g (4.5 ppb). This value represents the Total Dietary Concentration (TDC) of PCBs in forage fish that would meet the above NOAEL. All PCB criteria and guidelines currently under consideration for use as a TMDL target are presented in Table 4.2.

Table 4.2 Applicable water quality, fish tissue, and sediment criteria/guidelines for PCBs

Criteria		Aquatic Life (ppb)		Human Health (ppb)	
		Fresh Water			
		Acute	Chronic	Public Water Supplies	All Other Surface Waters
Water Column					
PCB-1260			0.014		
PCB-1254			0.014		
PCB-1248			0.014		
PCB-1242			0.014		
PCB-1232			0.014		
PCB-1221			0.014		
PCB-1016			0.014		
PCB Total				0.0017	0.0017
Fish Tissue					
DEQ Fish Tissue Screening Level					54
VDH Fish Tissue Screening Level (12/13/04)	Limited Consumption				50-500
	Do not eat				500
USFWS		4.5 ppb (Total Dietary Concentration for forage fish)			
Sediment					
PEC sediment quality guideline		676 ppb in sediment			

4.3 Fish Tissue and Sediment Monitoring Stations

Fish Tissue and sediment samples are collected by DEQ as part of the Virginia Fish Tissue and Sediment Contaminants Monitoring Program. Under this program, data are collected to assess the human health risks for individuals who may consume fish from state waters and to identify impaired aquatic ecosystems. The sampling program is charged with monitoring every major watershed in the state of Virginia at least once within a 2-3 year cycling period. In addition to "routine" samples taken as a part of the standard cycling period, monitoring at study sites may take place as part of the special Virginia Environmental Emergency Response Fund (VEERF) or in the case of a special request approved by DEQ.

From 1993 to 2002, 88 fish tissue and 207 sediment stations were sampled in the Roanoke River Basin. Of these, 27 fish tissue and 50 sediment stations were identified as priority stations because of their location on the Roanoke River mainstem (including the North and South Forks) or on a PCB impaired segment or lake section, according to the 2004 303(d) list. Fish tissue station locations and a summary of available data are presented in Figure 4.1 and Table 4.3. Sediment station locations and a summary of available data are presented in Figure 4.2 and Table 4.4.

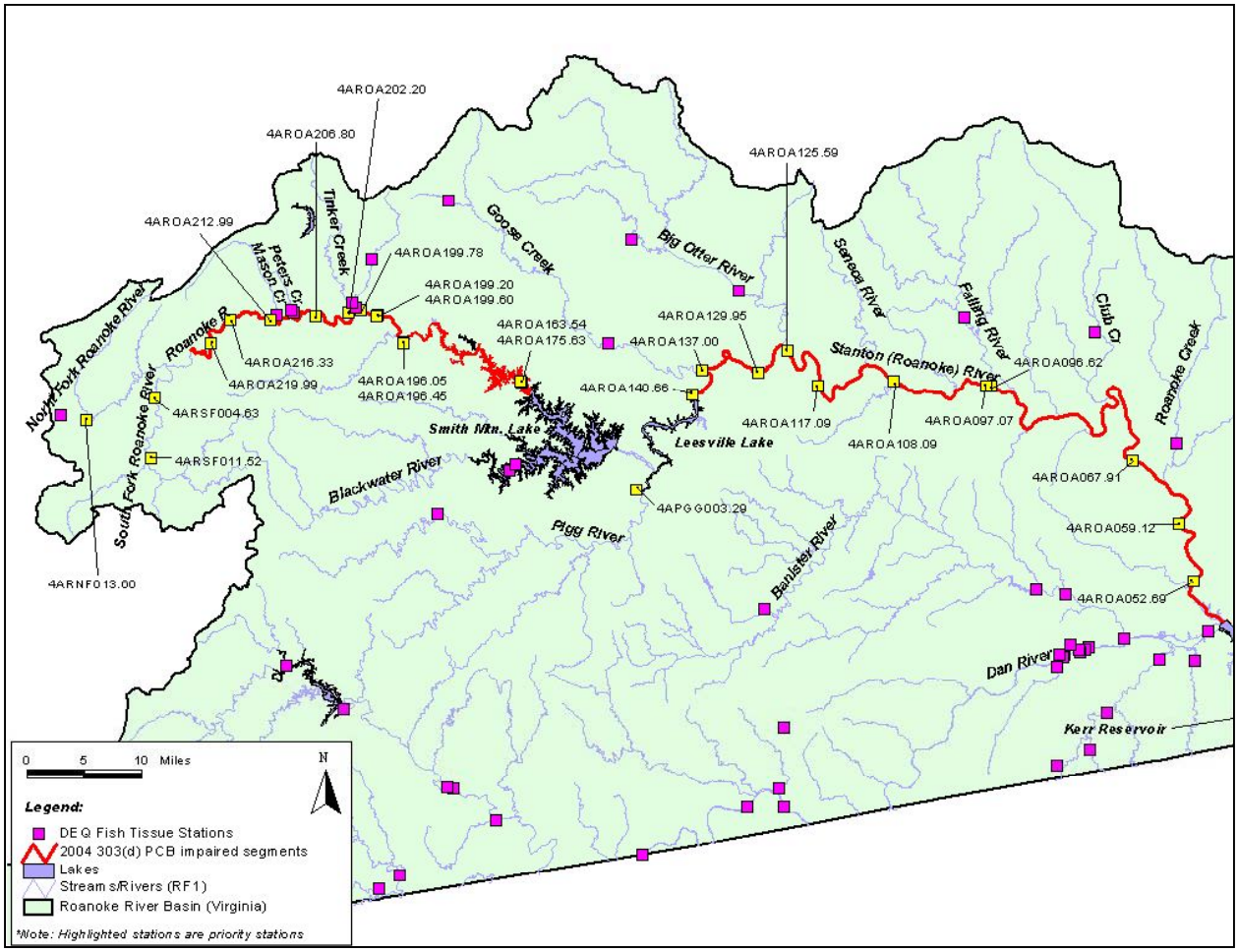

Figure 4.1 Fish tissue monitoring stations (priority stations highlighted)

Table 4.3 Fish tissue data summary

Station ID	Station Description	Begin Date	End Date	*Total Fish Analyzed	**Total PCB Samples
4ARSF011.52	South Fork Roanoke River	7/14/1993	7/14/1993	38	34
4ARSF004.63	South Fork Roanoke River near Rt. 636	10/15/1999	10/15/1999	19	3
4AROA219.99	Roanoke River near Glenvar	6/16/1993	5/29/2002	59	42
4AROA216.33	Roanoke River below Koppers, Salem	10/19/1999	7/23/2002	56	9
4AROA212.99	Roanoke River, Salem near Rt. 11 bridge	7/7/1999	7/7/1999	28	3
4AROA206.80	Roanoke River near Rt. 11 bridge (Ghent Park)	7/8/1999	8/22/2002	57	8
4AROA202.20	Roanoke River near 13th Street bridge	7/22/2002	7/22/2002	19	3
4AROA199.78	Roanoke River just above Niagara Dam	8/21/2002	8/21/2002	36	8
4AROA199.60	Roanoke River above Niagara Dam	10/18/1999	10/18/1999	23	4
4AROA199.20	Roanoke River just upstream Niagara Dam	7/13/1993	7/13/1993	40	40
4AROA196.45	Roanoke River (Smith Mt. Lake) at Hardy	9/15/1999	9/15/1999	40	5
4AROA196.05	Roanoke River near Hardy	8/21/2002	8/21/2002	41	9
4AROA175.63	Roanoke River (Smith Mt. Lake) at Hales Ford	11/17/1998	10/2/2002	94	16
4AROA163.54	Smith Mountain Lake near Hales Ford	6/9/1993	6/9/1993	41	39
4AROA140.66	Leesville Lake	11/19/1998	9/24/1999	72	11
4AROA137.00	Roanoke River near Leesville Tail Race	10/23/1998	10/23/1998	48	9
4AROA129.95	Roanoke River near Rt. 29 bridge at Altavista	6/10/2002	6/10/2002	19	5
4AROA125.59	Roanoke River downstream Altavista	10/22/1998	10/22/1998	73	14
4AROA117.09	Roanoke River near Taber	10/20/1999	10/27/1999	29	4
4AROA108.09	Roanoke River near Long Island	2/9/1993	10/21/1998	125	63
4AROA097.07	Roanoke River near Brookneal	2/9/1993	4/24/2002	175	61
4AROA096.62	Roanoke River near Brookneal (site #74)	5/9/2000	5/9/2000	10	2
4AROA067.91	Roanoke River near Rt. 746	8/5/1999	8/5/1999	34	5
4AROA059.12	Roanoke River near Rt. 360 - Clover	5/3/1993	5/2/2002	179	70
4AROA052.69	Roanoke River near Clover Landing	3/31/1999	5/13/1999	120	21
4ARNF013.60	North Fork Roanoke River	7/13/1993	5/28/2002	84	45
4APGG003.29	Pigg River near Leesville Lake	2/10/1993	9/23/1999	72	52

* Total Fish Analyzed is the total number of individual fish collected at a station over its entire sampling period

**Total PCB Samples is the total number of individual PCB values recorded for the sampled media at a sampling station over its entire sampling period

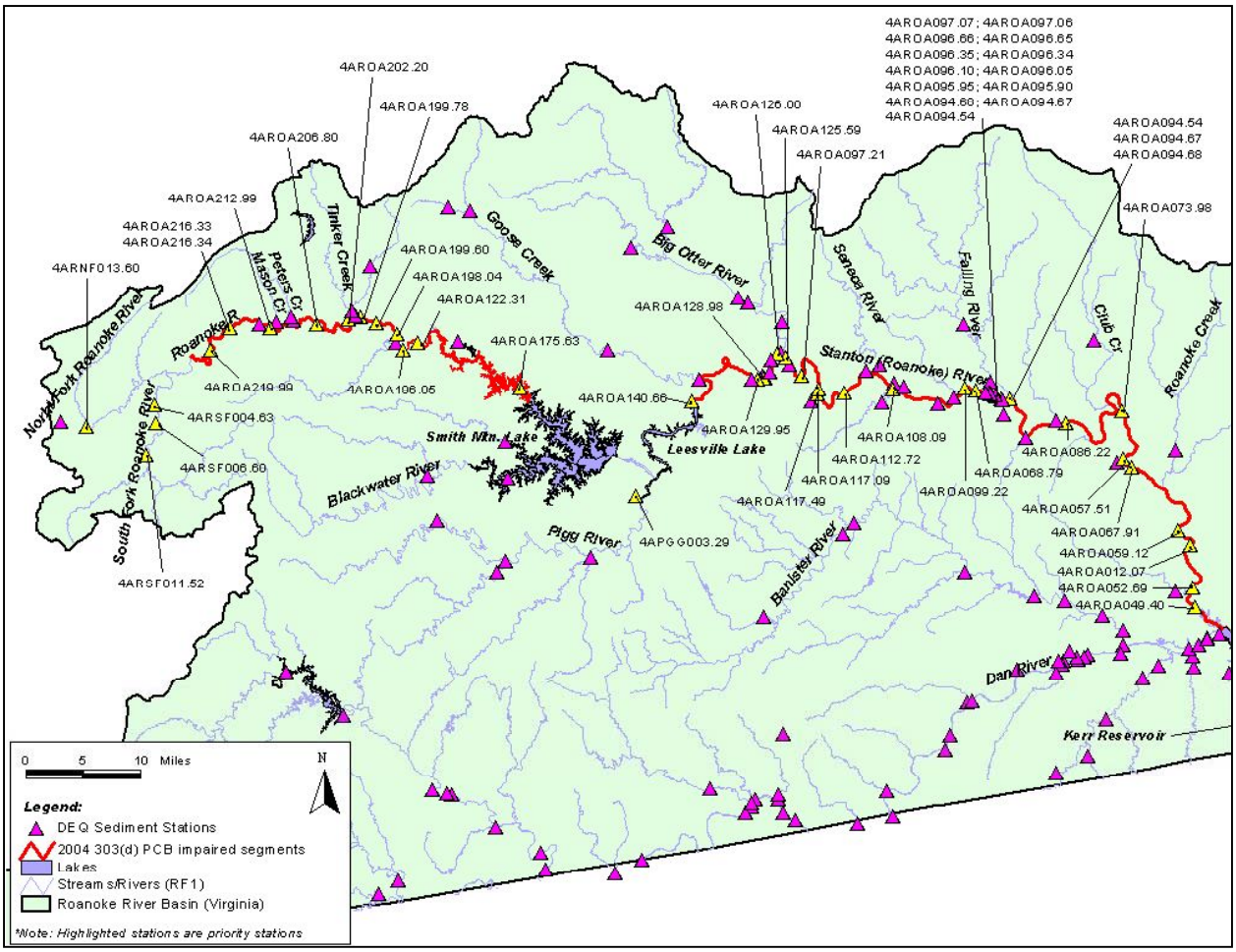

Figure 4.2 Sediment monitoring stations (priority stations highlighted)

Table 4.4 Sediment data summary

Station ID	Station Description	Begin Date	End Date	**Total PCB Samples
4ARSF011.52	South Fork Roanoke River	7/23/1996	7/23/1996	1
4ARSF006.60	South Fork Roanoke River	7/23/1996	7/23/1996	1
4ARSF004.63	South Fork Roanoke River near Rt. 636	6/29/1999	6/29/1999	1
4AROA219.99	Roanoke River near Glenvar	5/29/2002	5/29/2002	1
4AROA216.34	Roanoke River	8/6/1997	8/6/1997	1
4AROA216.33	Roanoke River, Salem below Koppers	7/1/1999	7/1/1999	0
4AROA212.99	Roanoke River, Salem near Rt. 11 bridge	7/7/1999	7/7/1999	1
4AROA206.80	Roanoke River at Wasena Park near Rt. 11 bridge	7/8/1999	7/22/2002	2
4AROA202.20	Roanoke River at 13th Street bridge	7/22/2002	7/22/2002	1
4AROA199.78	Roanoke River just above Niagara Dam	8/21/2002	8/21/2002	1
4AROA199.60	Roanoke River above Niagara Dam	10/18/1999	10/18/1999	1
4AROA198.04	Roanoke River	8/6/1997	8/6/1997	1
4AROA196.05	Roanoke River (SMLake) near Hardy	9/15/1999	8/21/2002	2

Station ID	Station Description	Begin Date	End Date	**Total PCB Samples
4AROA175.63	Roanoke River (SMLake) near Hales Ford bridge	9/14/1999	10/2/2002	2
4AROA140.66	Roanoke River (Leesville Lake-Lower Lake site)	9/24/1999	9/24/1999	0
4AROA137.00	Roanoke River near Leesville Tail Race	10/23/1998	10/23/1998	0
4AROA129.95	Roanoke River near Rt. 29 bridge at Altavista	6/10/2002	6/10/2002	1
4AROA128.98	Roanoke River at Rt. 668 near Altavista Park	7/30/1999	7/30/1999	1
4AROA126.00	Roanoke River upstream of Big Otter River	10/22/1998	10/22/1998	1
4AROA125.59	Roanoke River downstream Altavista	10/22/1998	10/22/1998	1
4AROA122.31	Roanoke River	7/13/1996	7/13/1996	1
4AROA117.49	Roanoke River	7/15/1997	7/15/1997	2
4AROA117.09	Roanoke River near Taber	10/20/1999	10/20/1999	1
4AROA112.72	Roanoke River	7/15/1997	7/15/1997	1
4AROA108.09	Roanoke River near Long Island	10/21/1998	10/21/1998	1
4AROA099.22	Roanoke River	7/31/1997	7/31/1997	1
4AROA097.21	Roanoke River	6/19/1996	6/19/1996	1
4AROA097.07	Roanoke River near Brookneal	10/26/1998	4/24/2002	3
4AROA097.06	Middle Roanoke River at Rt. 501	6/2/1999	6/2/1999	0
4AROA096.66	Downstream of lagoon outfall	6/2/1999	6/2/1999	0
4AROA096.65	Downstream of Tanyard Branch	6/2/1999	6/2/1999	1
4AROA096.35	Downstream of Hatchery Water Intake	6/2/1999	6/2/1999	0
4AROA096.34	Directly across from site of sample # 10	6/2/1999	6/2/1999	0
4AROA096.10	South bank, upstream of Hatchery culvert	6/2/1999	6/2/1999	0
4AROA096.05	North bank, upstream of rusty culvert	6/2/1999	6/2/1999	0
4AROA095.95	North bank, downstream of last set of Hatchery Ponds	6/3/1999	6/3/1999	0
4AROA095.90	South bank,across from sample #16 of Roanoke River	6/3/1999	6/3/1999	0
4AROA094.68	Middle, just downstream of RR Bridge trestle	6/3/1999	6/3/1999	0
4AROA094.67	North bank, downstream of Railroad (RR) Bridge	6/3/1999	6/3/1999	0
4AROA094.54	Downstream of RR Bridge,south side of sandy island	6/3/1999	6/3/1999	0
4AROA086.22	Roanoke River	7/17/1997	7/17/1997	1
4AROA073.98	Roanoke River	8/6/1997	8/6/1997	1
4AROA068.79	Roanoke River	6/19/1996	6/19/1996	1
4AROA067.91	Roanoke River near Rt. 746 bridge	8/5/1999	8/5/1999	1
4AROA059.12	Roanoke River near Clover	10/27/1998	4/17/2002	2
4AROA057.51	Roanoke River	6/19/1996	6/19/1996	1
4AROA052.69	Roanoke River, upstream Kerr Reservoir	3/31/1999	3/31/1999	1
4AROA049.40	Roanoke River	8/6/1997	8/6/1997	1
4AROA012.07	Roanoke River	6/12/1996	6/12/1996	1
4ARNF013.60	North Fork Roanoke River near Rt. 603	6/30/1999	5/28/2002	3

**Total PCB Samples is the total number of individual PCB values recorded for the sampled media at a sampling station over its entire sampling period

4.4 Water Quality Monitoring Stations

From 1967 to 2004, 429 water quality stations were sampled for PCBs in the Roanoke River Basin. Of these, 53 were identified as priority stations, as discussed above. Water quality station locations and a data summary are presented in Figure 4.3 and Table 4.5.

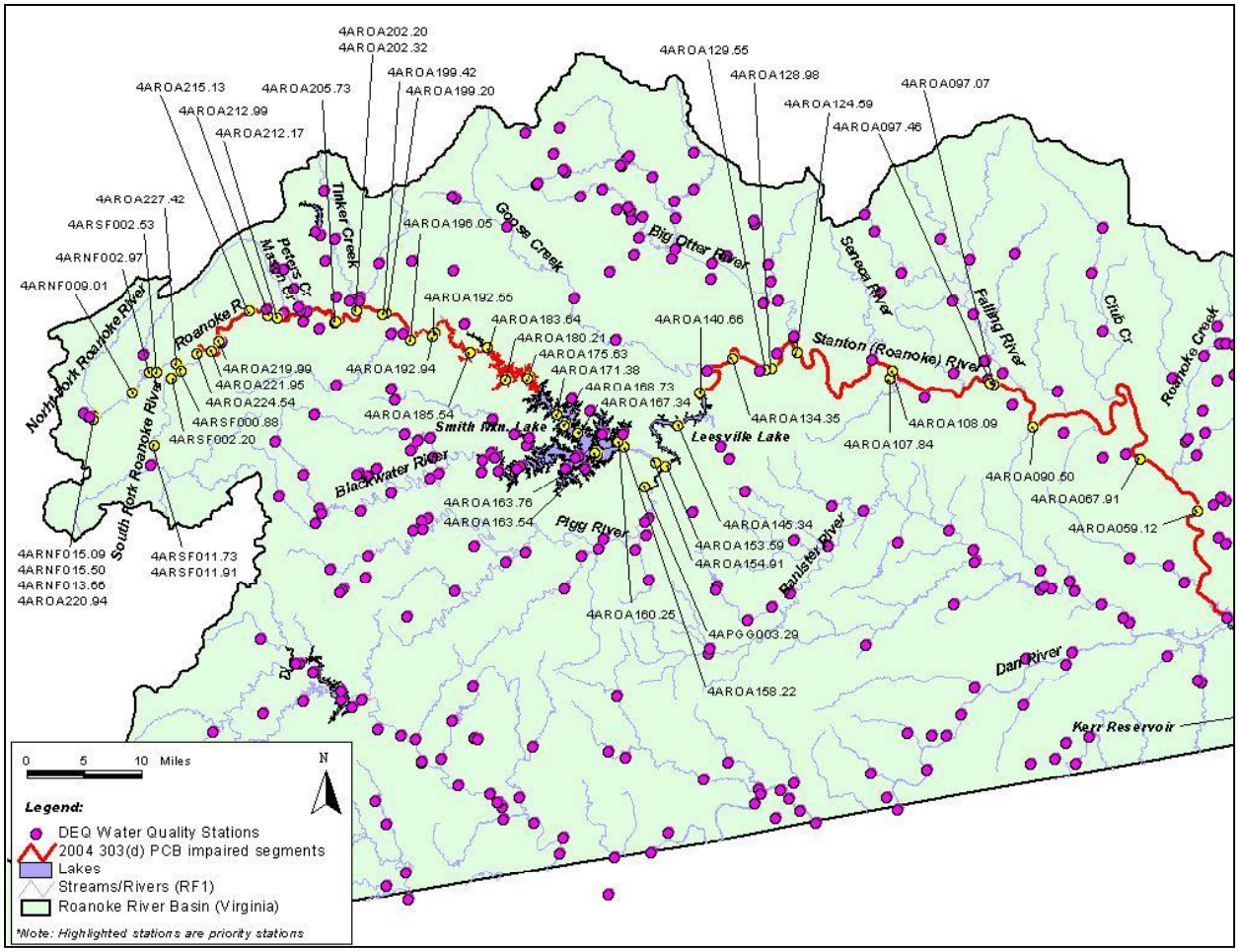

Figure 4.3 Water quality monitoring stations with PCB observations (priority stations highlighted)

Table 4.5 Water column PCB data summary

					Sample Count							
Station ID	Station Description	Begin Date	End Date	Sample Type	PCB 1016	PCB 1221	PCB 1232	PCB 1242	PCB 1248	PCB 1254	PCB 1260	Total PCBs
4ARSF011.91	ROUTE 637 BRIDGE AT GAGE	6/16/82	5/4/83	AMBNT	0	0	0	0	0	0	0	0
4ARSF011.73	RT. 637 BRIDGE AT GAGE	7/22/99	6/6/01	AMBNT	0	0	0	0	0	0	0	0
4ARSF002.53	RT. 460/11 BRIDGE AT ELLISTON ABOVE GREE	3/16/70	7/30/70	AMBNT	0	0	0	0	0	0	0	0
4ARSF002.20	PRIVATE BRIDGE UPSTREAM FROM GREEN HILL	8/27/92	6/6/01	AMBNT	0	0	0	0	0	0	0	0
4ARSF000.88	RT. 460/11 BRIDGE BELOW GREEN HILL, INC.	7/20/79	6/16/88	AMBNT	1	1	1	1	1	0	1	0
4AROA227.42	RT. 773 AT GAGING STA. IN LAFAYETTE	3/16/70	11/16/04	AMBNT	1	1	1	1	1	0	1	0
4AROA224.54	ROUTE 639 BRIDGE NEAR DIXIE CAVERNS - RO	7/15/03	11/16/04	AMBNT	0	0	0	0	0	0	0	0

Station ID	Station Description	Begin Date	End Date	Sample Type	Sample Count							
					PCB 1016	PCB 1221	PCB 1232	PCB 1242	PCB 1248	PCB 1254	PCB 1260	Total PCBs
4AROA221.95	Above Rt. 639 Bridge near Wabun	4/25/02	4/25/02	AMBNT	0	0	0	0	0	0	0	0
4AROA220.94	Rt. 639 Bridge south of Wabun	7/15/03	11/16/04	AMBNT	0	0	0	0	0	0	0	0
4AROA219.99	ROUTE 612 BRIDGE ABOVE SALEM AT WABUM	1/16/68	7/30/70	AMBNT	0	0	0	0	0	0	0	0
4AROA215.13	Mill Lane Bridge, Salem, VA	7/15/03	11/16/04	AMBNT	0	0	0	0	0	0	0	0
4AROA212.99	ROUTE 11 BRIDGE ABOVE EATON, INC.	9/26/67	7/26/71	AMBNT	0	0	0	0	0	0	0	0
4AROA212.17	ROUTE 11 BRIDGE BELOW EATON, INC.	2/6/68	11/16/04	AMBNT	0	0	0	0	0	0	0	0
4AROA205.73	Franklin Road Bridge, Roanoke, VA	7/21/03	11/17/04	AMBNT	0	0	0	0	0	0	0	0
4AROA202.32	Upstream of 14th St. Bridge	5/3/04	5/3/04	AMBNT	0	0	0	0	0	0	0	0
4AROA202.20	13TH. ST. BRIDGE ABOVE ROANOKE STP	3/16/70	11/9/04	AMBNT	1	1	1	1	1	0	1	0
4AROA199.42	SPILLWAY NIAGRA RESERVOIR (ROANOKE CO)	8/31/77	8/31/77	AMBNT	0	0	0	0	0	0	0	0
4AROA199.20	BLUE RIDGE PARKWAY BR. BELOW ROANOKE	9/26/67	5/18/83	AMBNT	0	0	0	0	0	0	0	0
4AROA196.05	SMITH MTN. LAKE, MCVEIGH FORD	8/12/75	6/5/03	AMBNT	0	0	0	0	0	0	0	0
4AROA192.94	SMITH MTN LAKE #2A-TOP-HARDYS FORD #2C-B	4/25/83	6/5/03	AMBNT	0	0	0	0	0	0	0	0
4AROA192.55	SMITH MTN. LAKE, HARDYS FORD	6/29/72	11/9/04	AMBNT	1	1	1	1	1	0	1	0
4AROA185.54	SMITH MTN. LAKE, LYNVILLE	6/29/72	10/26/73	AMBNT	0	0	0	0	0	0	0	0
4AROA183.64	SMITH MTN LK 3A-TOP,3B-MID,3C-BOT CONF B	4/25/83	6/5/03	AMBNT	0	0	0	0	0	0	0	0
4AROA180.21	STATION 12 CONFLUENCE WITH INDIAN CRK	4/24/85	6/5/03	AMBNT	0	0	0	0	0	0	0	0
4AROA175.63	SMITH MTN. LAKE, HALES FORD	6/29/72	6/5/03	AMBNT	0	0	0	0	0	0	0	0
4AROA171.38	SMITH MTN. LAKE - BUOY 15R	6/29/72	10/26/73	AMBNT	0	0	0	0	0	0	0	0
4AROA168.73	SMITH MTN. LAKE - BUOY 12R	6/29/72	6/15/76	AMBNT	0	0	0	0	0	0	0	0
4AROA167.34	BUOY 12	4/25/85	6/10/03	AMBNT	0	0	0	0	0	0	0	0
4AROA163.76	SMITH MTN LK 6A-TOP,6B-MID,6C-BOT CONF B	4/13/83	6/10/03	AMBNT	1	1	1	1	1	0	1	0
4AROA163.54	SMITH MTN. LAKE - BUOY 6R	6/29/72	10/26/73	AMBNT	0	0	0	0	0	0	0	0
4AROA160.25	SMITH MTN. LAKE - BUOY 2R	6/29/72	10/14/87	AMBNT	0	0	0	0	0	0	0	0
4AROA158.22	SMITH MTN LK #5A-TOP DAM #5B-MID DAM #5C	4/13/83	6/10/03	AMBNT	0	0	0	0	0	0	0	0
4AROA154.91	LEESVILLE LAKE #4A-TOP/CONFLUENCE W/CLAY	7/14/77	6/17/86	AMBNT	0	0	0	0	0	0	0	0
4AROA153.59	LEESVILLE LAKE #3A-TOP-CONFLUENCE W/ PIG	7/14/77	6/12/03	AMBNT	0	0	0	0	0	0	0	0
4AROA145.34	LEESVILLE LK #2A-RMP BEDFORD/CAMPBELL CO	7/14/77	6/12/03	AMBNT	0	0	0	0	0	0	0	0
4AROA140.66	LEESVILLE LK #1A-TOP #1B-MIDDLE #1C-BOT	7/14/77	6/12/03	AMBNT	0	0	0	0	0	0	0	0
4AROA134.35	South of Rt. 43 and above Alta Vista	6/3/02	5/27/03	AMBNT	0	0	0	0	0	0	0	0
4AROA129.55	ROUTE 29 BRIDGE, AT GAGE - PITTSYLVANIA	11/13/91	11/17/04	AMBNT	0	0	0	0	0	0	0	0
4AROA128.98	ROUTE 668 BRIDGE AT ALTAVISTA	1/22/68	5/13/70	AMBNT	0	0	0	0	0	0	0	0
4AROA124.59	ROUTE 640 BRIDGE - CAMPBELL COUNTY	4/23/69	6/11/01	AMBNT	0	0	0	0	0	0	0	0
4AROA108.09	RT. 761 BRIDGE - MAIN CHANNEL OF ROANOKE	2/23/93	6/9/03	AMBNT	0	0	0	0	0	0	0	0

Station ID	Station Description	Begin Date	End Date	Sample Type	Sample Count							
					PCB 1016	PCB 1221	PCB 1232	PCB 1242	PCB 1248	PCB 1254	PCB 1260	Total PCBs
4AROA107.84	ABOVE BROOKNEAL , ROUTE 761 BR. NEAR LON	3/28/75	8/6/79	AMBNT	0	0	0	0	0	0	0	0
4AROA097.46	ROANOKE RIVER AT BROOKNEAL GAGE , RT. 50	9/11/79	9/30/04	AMBNT	2	2	2	2	2	0	2	0
4AROA097.07	ROUTE 501 AT BROOKNEAL	4/23/69	5/13/70	AMBNT	0	0	0	0	0	0	0	0
4AROA090.50	ROUTE 620 SOUTH OF BROOKNEAL	3/17/70	12/13/73	AMBNT	0	0	0	0	0	0	0	0
4AROA067.91	RT.746 BRIDGE (WATKINS BRIDGE) NEAR RAND	7/2/90	10/12/04	AMBNT	0	0	0	0	0	0	0	0
4AROA059.12	ROUTE 360 BRIDGE, EAST OF CLOVER	1/22/68	11/8/04	AMBNT	1	1	1	1	1	0	1	0
4ARNF015.50	Above Rt. 603 and behind church	11/8/01	11/8/01	AMBNT	0	0	0	0	0	0	0	0
4ARNF015.09	BELOW RT. 603 BRIDGE	7/22/99	5/28/03	AMBNT	0	0	0	0	0	0	0	0
4ARNF013.66	ROUTE 603 BRIDGE NEAR ELLETT - MONTGOMER	3/16/70	11/15/04	AMBNT	1	1	1	1	1	0	1	0
4ARNF009.01	Sisson & Ryan property off Rt. 687	11/8/01	11/8/01	AMBNT	0	0	0	0	0	0	0	0
4ARNF002.97	ROUTE 603 BRIDGE	6/16/82	4/14/99	AMBNT	0	0	0	0	0	0	0	0

4.5 Fish Tissue PCB Results

Fish tissue samples were collected and analyzed by DEQ under the Fish Tissue and Sediment Monitoring Program. These data were compiled and summarized in order to help identify spatial and temporal trends that will assist in the identification of potential PCBs sources in the Roanoke River Basin. It should be noted that the mobility and seasonal migration patterns of various fish species can limit the conclusions that can be drawn from analyzing the spatial distribution of PCB concentrations in fish tissue samples. The location of dams, tributaries, and other physical characteristics can influence the PCB signature in fish tissue samples. These and other considerations must be taken into consideration during data analysis and source identification. More important, if they exist, is the identification of correlations between observed fish tissue and sediment PCBs concentrations. Data analysis observations are noted at the end of Sections 4.4 and 4.5.

Fish tissue PCB results are shown using graduated symbols in Figure 4.4. These symbols vary in size according to the average total PCB concentration observed in all fish species collected and analyzed for the entire sampling period at each monitoring station. The data intervals shown in the legend correspond with the DEQ PCB fish tissue screening value (54 ppb) and the former VDH fish consumption advisory level (600 ppb). Current VDH fish consumption criteria are listed in Table 4.2.

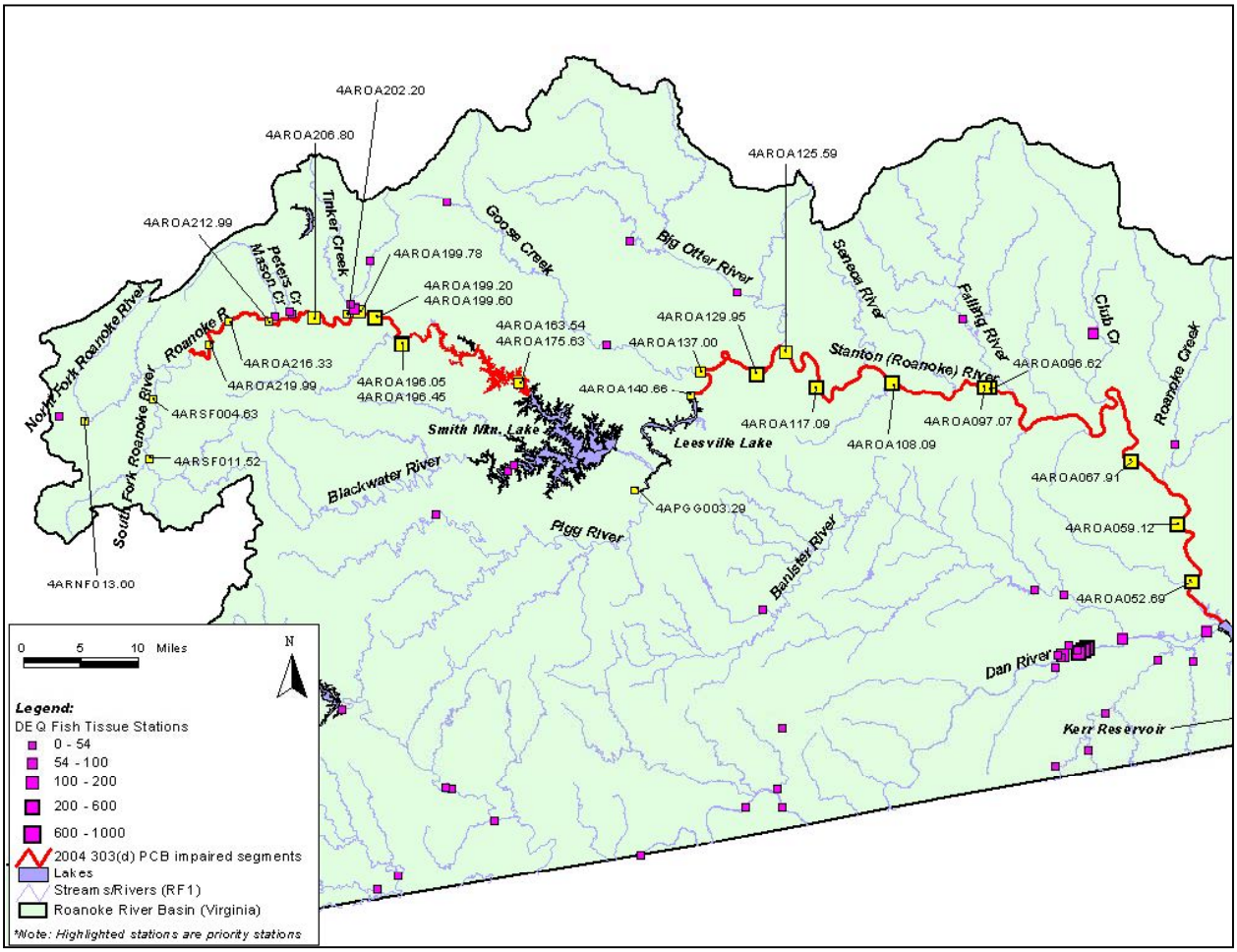

Figure 4.4 Fish tissue PCB results (average total PCB concentration for all species, 1993-2003)

For data analysis purposes, the Roanoke River Basin was divided into three sections. The Upper Roanoke section includes the area from the headwaters (North and South Forks of the Roanoke River) downstream to Niagara Dam (below the City of Roanoke). The Middle Roanoke section includes all monitoring stations from Niagara Dam downstream to Leesville Dam. The Lower Roanoke section includes the Staunton (Roanoke) River from Leesville Dam downstream to Kerr Reservoir (confluence with the Dan River).

Figures 4.5 through 4.7 present the average total PCB concentrations for each fish species collected at priority fish tissue sampling stations over the entire sampling period (fish species abbreviations are presented in Tables 4.6 through 4.8). The sampling date shown represents the most recent sampling event that occurred at each station. Within each species, stations are presented in an upstream – downstream progression for spatial analysis purposes, according to the station river-mile code. The number displayed at the top of each bar represents the sample count. The absence of a number indicates that the data point represents a single sample. The DEQ fish tissue screening level (54 ppb) and former VDH fish consumption advisory level (600 ppb) are also shown. Tables 4.6 through 4.8 present the average total PCB concentration by sample year for each fish species collected at priority fish tissue sampling stations.

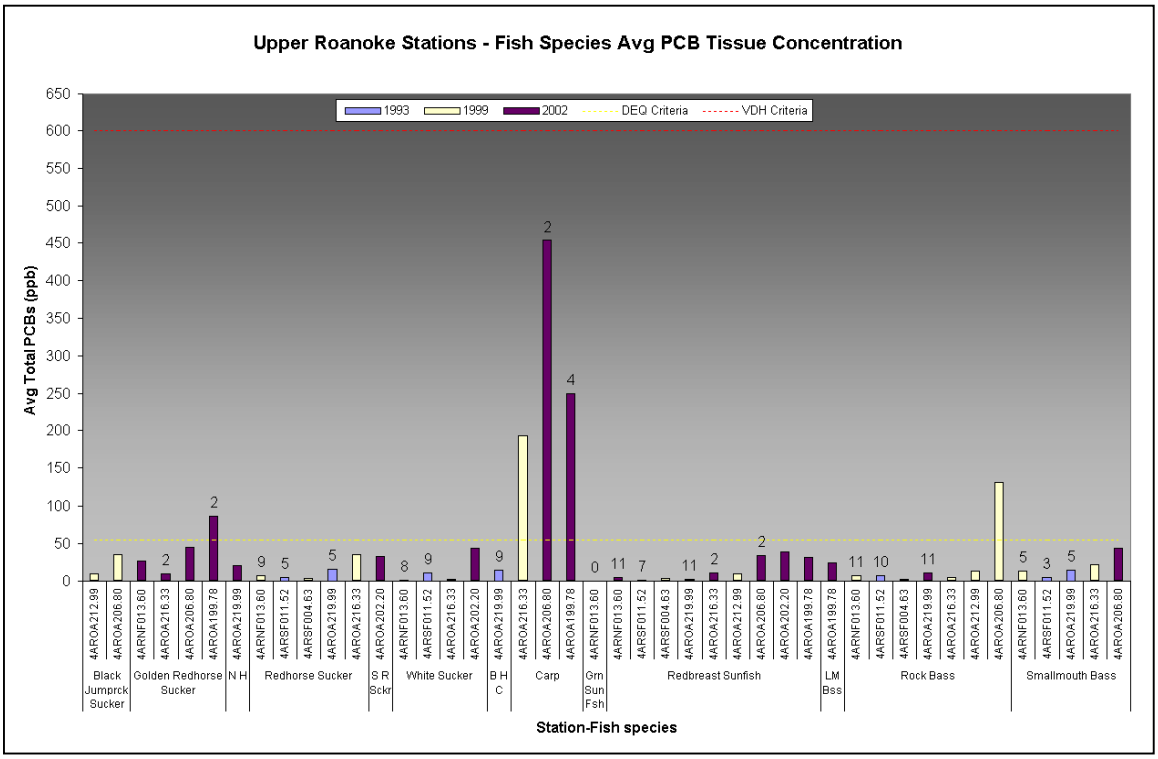

Figure 4.5 Upper Roanoke – Fish tissue PCB results by species

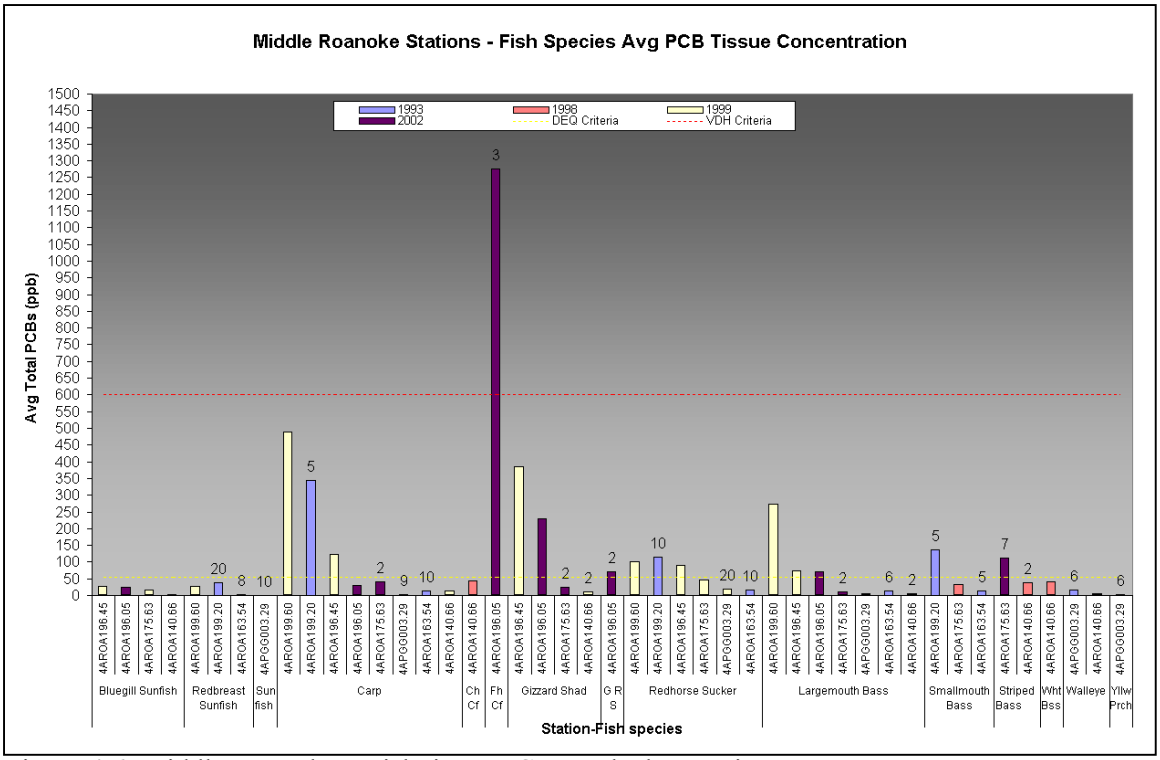

Figure 4.6 Middle Roanoke – Fish tissue PCB results by species

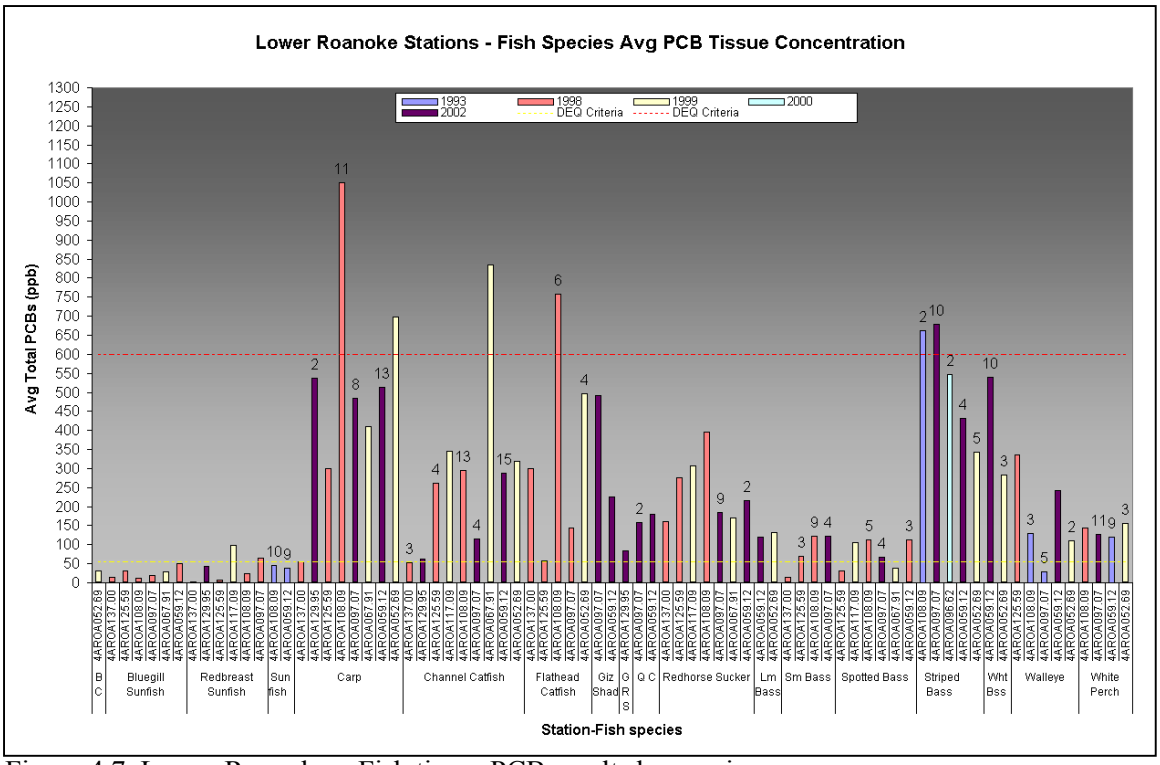

Figure 4.7 Lower Roanoke – Fish tissue PCB results by species

Table 4.6 Upper Roanoke – Fish Tissue PCB results by species/sample year

Upper Roanoke			Average Total PCB (ppb (wet weight basis)) SamplingYear		
Fish species name	Species Abbreviation	DEQ Site	1993	1999	2002
Black Jumprock Sucker	Black Jumprck Sucker	4AROA212.99		9.659	
		4AROA206.80		35.317	
Bluehead Chub	B H C	4AROA219.99	14.000		
Carp	Carp	4AROA216.33		192.323	
		4AROA206.80			454.128
		4AROA199.78			249.298
Golden Redhorse Sucker	Golden Redhorse Sucker	4ARNF013.60			26.625
		4AROA216.33			9.679
		4AROA206.80			44.717
		4AROA199.78			86.533
Green Sunfish	Grn Sun Fsh	4ARNF013.60			
Largemouth Bass	LM Bss	4AROA199.78			23.740
Northern Hogsucker	N H	4AROA219.99			20.270
Redbreast Sunfish	Redbreast Sunfish	4ARNF013.60	5.030		2.036
		4ARSF011.52	1.271		
		4ARSF004.63		3.824	
		4AROA219.99	2.770		2.542
		4AROA216.33		16.682	5.846
		4AROA212.99		9.924	
		4AROA206.80		38.739	30.290
		4AROA202.20			38.687
		4AROA199.78			30.985
Redhorse Sucker	Redhorse Sucker	4ARNF013.60	5.875	13.605	
		4ARSF011.52	4.440		
		4ARSF004.63		3.034	
		4AROA219.99	16.000		
		4AROA216.33		34.686	
Rock Bass	Rock Bass	4ARNF013.60	7.880	1.727	

Upper Roanoke			Average Total PCB (ppb (wet weight basis))		
			SamplingYear		
Fish species name	Species Abbreviation	DEQ Site	1993	1999	2002
		4ARSF011.52	7.040		
		4ARSF004.63		2.913	
		4AROA219.99	11.660		6.606
		4AROA216.33		4.380	
		4AROA212.99		13.058	
		4AROA206.80		130.466	
Shorthead Redhorse Sucker	S R Sckr	4AROA202.20			32.660
Smallmouth Bass	Smallmouth Bass	4ARNF013.60	15.375	5.488	
		4ARSF011.52	5.300		
		4AROA219.99	14.220		
		4AROA216.33		21.531	
		4AROA206.80			43.275
White Sucker	White Sucker	4ARNF013.60	1.443		3.423
		4ARSF011.52	11.456		
		4AROA216.33			2.093
		4AROA202.20			44.067

Table 4.7 Middle Roanoke – Fish Tissue PCB results by species/sample year

Middle Roanoke			Average Total PCB (ppb (wet weight basis))			
			SamplingYear			
Fish species name	Species Abbreviation	DEQ Site	1993	1998	1999	2002
Bluegill Sunfish	Bluegill Sunfish	4AROA196.45			26.283	
		4AROA196.05				24.576
		4AROA175.63			16.025	
		4AROA140.66			1.542	
Carp	Carp	4AROA199.60			488.942	
		4AROA199.20	343.140			
		4AROA196.45			123.984	
		4AROA196.05				30.921
		4AROA175.63			45.105	35.165
		4APGG003.29	2.538		10.741	
		4AROA163.54	13.500			
		4AROA140.66			14.619	
Channel Catfish	Ch Cf	4AROA140.66		44.972		
Flathead Catfish	Fh Cf	4AROA196.05				1276.417
Gizzard Shad	Gizzard Shad	4AROA196.45			386.407	
		4AROA196.05				228.695
		4AROA175.63		37.625		11.347
		4AROA140.66		6.851	12.737	
Golden Redhorse Sucker	G R S	4AROA196.05				70.265
Largemouth Bass	Largemouth Bass	4AROA199.60			271.885	
		4AROA196.45			73.651	
		4AROA196.05				70.524
		4AROA175.63			9.089	10.156
		4APGG003.29			4.435	
		4AROA163.54	12.633			
		4AROA140.66		1.879	9.502	
Redbreast Sunfish	Redbreast Sunfish	4AROA199.60			26.478	
		4AROA199.20	39.040			
		4AROA163.54	3.150			
Redhorse Sucker	Redhorse Sucker	4AROA199.60			100.541	
		4AROA199.20	114.570			
		4AROA196.45			89.938	
		4AROA175.63			47.666	
		4APGG003.29	20.379		1.105	
		4AROA163.54	15.840			
Smallmouth Bass	Smallmouth Bass	4AROA199.20	135.900			
		4AROA175.63		32.873		
		4AROA163.54	12.580			
Striped Bass	Striped Bass	4AROA175.63		111.946		111.270
		4AROA140.66		39.037		

Middle Roanoke			Average Total PCB (ppb (wet weight basis))			
			SamplingYear			
Fish species name	Species Abbreviation	DEQ Site	1993	1998	1999	2002
Sunfish	Sun fish	4APGG003.29	0.900			
Walleye	Walleye	4APGG003.29	17.033			
		4AROA140.66		4.822		
White Bass	Wht Bss	4AROA140.66		40.027		
Yellow Perch	Yllw Prch	4APGG003.29	2.020		0.181	

Table 4.8 Lower Roanoke – Fish Tissue PCB results by species/sample year

Lower Roanoke			Average Total PCB (ppb (wet weight basis))				
			SamplingYear				
Fish species name	Species Abbreviation	DEQ Site	1993	1998	1999	2000	2002
Black Crappie	B C	4AROA052.69			32.027		
Bluegill Sunfish	Bluegill Sunfish	4AROA137.00		14.399			
		4AROA125.59		31.471			
		4AROA108.09		12.879			
		4AROA097.07		19.643			
		4AROA067.91			27.998		
		4AROA059.12		51.534			
Carp	Carp	4AROA137.00		56.062			
		4AROA129.95					536.732
		4AROA125.59		300.622			
		4AROA108.09	1058.210	976.779			
		4AROA097.07	479.800	297.267			700.341
		4AROA067.91			409.007		
		4AROA059.12	551.050	129.323			513.452
		4AROA052.69			699.023		
Channel Catfish	Channel Catfish	4AROA137.00		51.886			
		4AROA129.95					61.471
		4AROA125.59		262.577			
		4AROA117.09			344.968		
		4AROA108.09	260.000	416.841			
		4AROA097.07		115.949			109.634
		4AROA067.91			833.628		
		4AROA059.12	283.833	279.768			301.971
		4AROA052.69			318.138		
Flathead Catfish	Flathead Catfish	4AROA137.00		299.923			
		4AROA125.59		58.079			
		4AROA108.09		757.684			
		4AROA097.07		144.748			
		4AROA052.69			497.110		
Gizzard Shad	Giz Shad	4AROA097.07					490.980
		4AROA059.12					224.504
Golden Redhorse Sucker	G R S	4AROA129.95					83.095
Largemouth Bass	Lm Bass	4AROA059.12					119.273
		4AROA052.69			132.751		
Quillback Carpsucker	Q C	4AROA097.07		144.536			174.190
		4AROA059.12					179.001
Redbreast Sunfish	Redbreast Sunfish	4AROA137.00		1.423			
		4AROA129.95					43.416
		4AROA125.59		8.263			
		4AROA117.09			99.530		
		4AROA108.09		23.066			
		4AROA097.07		64.097			
Redhorse Sucker	Redhorse Sucker	4AROA137.00		160.536			
		4AROA125.59		275.602			
		4AROA117.09			307.929		
		4AROA108.09		396.668			
		4AROA097.07	138.886	498.005			194.449
		4AROA067.91			171.216		
		4AROA059.12		388.245			44.815
Smallmouth Bass	Sm Bass	4AROA137.00		14.443			
		4AROA125.59		70.008			

Lower Roanoke			Average Total PCB (ppb (wet weight basis))				
			SamplingYear				
Fish species name	Species Abbreviation	DEQ Site	1993	1998	1999	2000	2002
		4AROA108.09	48.475	716.638			
		4AROA097.07		120.045			132.857
Spotted Bass	Spotted Bass	4AROA125.59		30.759			
		4AROA117.09			106.538		
		4AROA108.09	130.950	37.131			
		4AROA097.07		60.525			91.197
		4AROA067.91			38.766		
		4AROA059.12		113.723			
Striped Bass	Striped Bass	4AROA108.09	661.300				
		4AROA097.07	903.800				454.020
		4AROA096.62				546.300	
		4AROA059.12					432.803
		4AROA052.69			343.563		
Sunfish	Sun fish	4AROA108.09	46.280				
		4AROA059.12	39.289				
Walleye	Walleye	4AROA125.59		336.545			
		4AROA108.09	129.200				
		4AROA097.07	27.640				
		4AROA059.12					241.852
		4AROA052.69			109.226		
White Bass	Wht Bss	4AROA059.12	578.338				379.555
		4AROA052.69			282.629		
White Perch	White Perch	4AROA108.09		144.347			
		4AROA097.07	121.960				178.857
		4AROA059.12	120.111				
		4AROA052.69			156.225		

Individual species graphs are shown in Figures 4.8 through 4.14 (all Roanoke Basin stations are shown for each species). The sampling date shown represents the most recent sampling event that occurred at each station. Within each species, stations are presented in an upstream – downstream progression for spatial analysis purposes, according to the station river-mile code. The number displayed at the top of each bar represents the sample count. The absence of a number indicates that the data point represents a single sample. The DEQ fish tissue screening level (54 ppb) and former VDH fish consumption advisory level (600 ppb) are also shown.

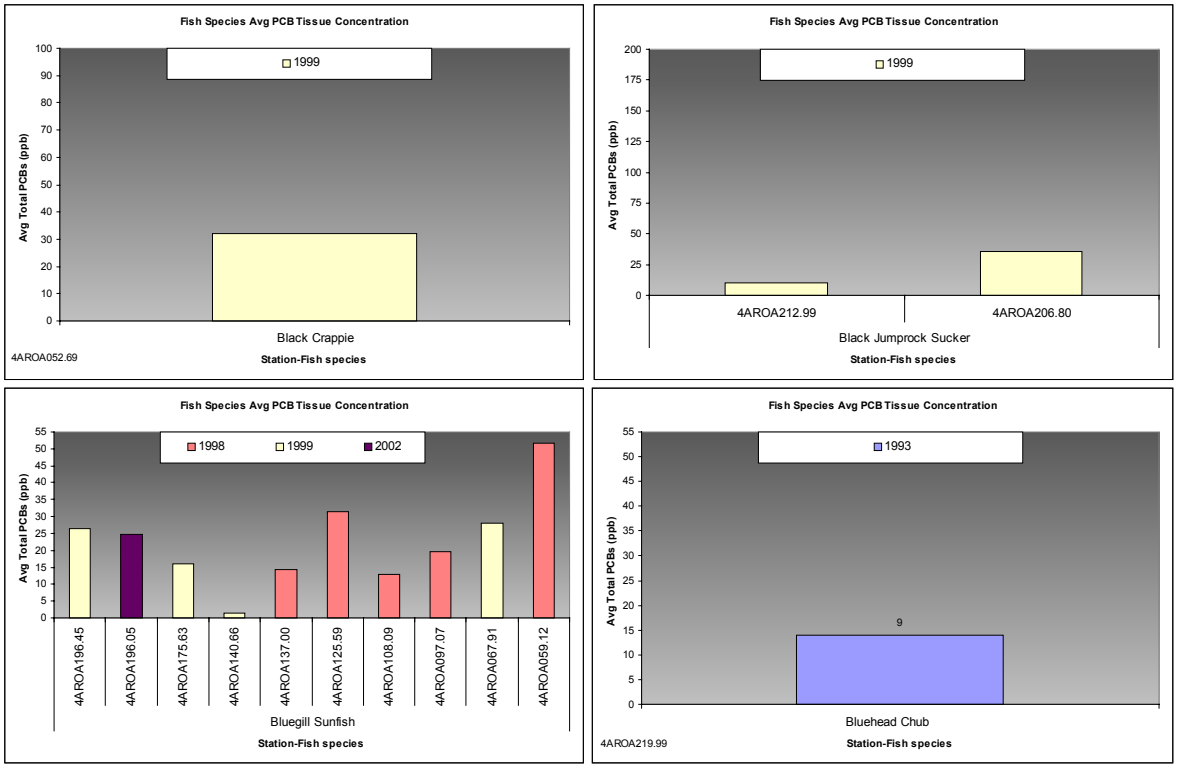

Figure 4.8 Individual fish species PCB results: Black Crappie, Black Jumprock Sucker, Bluegill Sunfish, Bluehead Chub

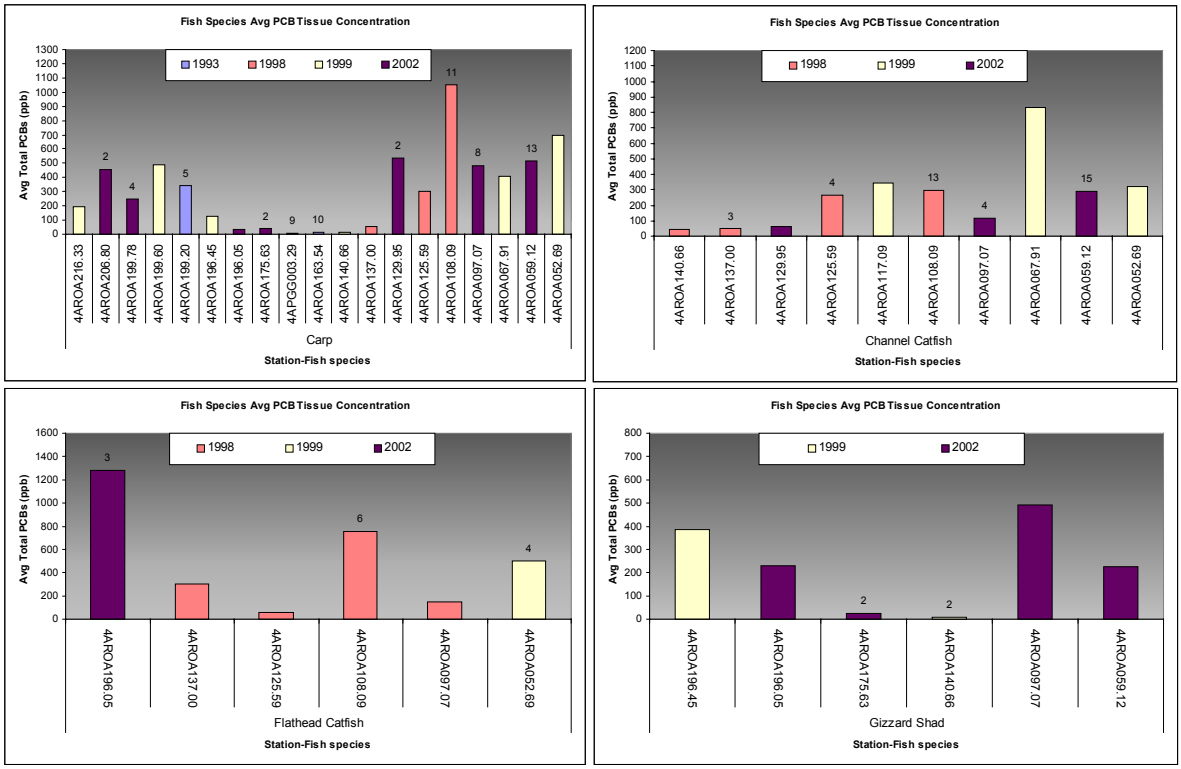

Figure 4.9 Individual fish species PCB results: Carp, Channel Catfish, Flathead Catfish, Gizzard Shad

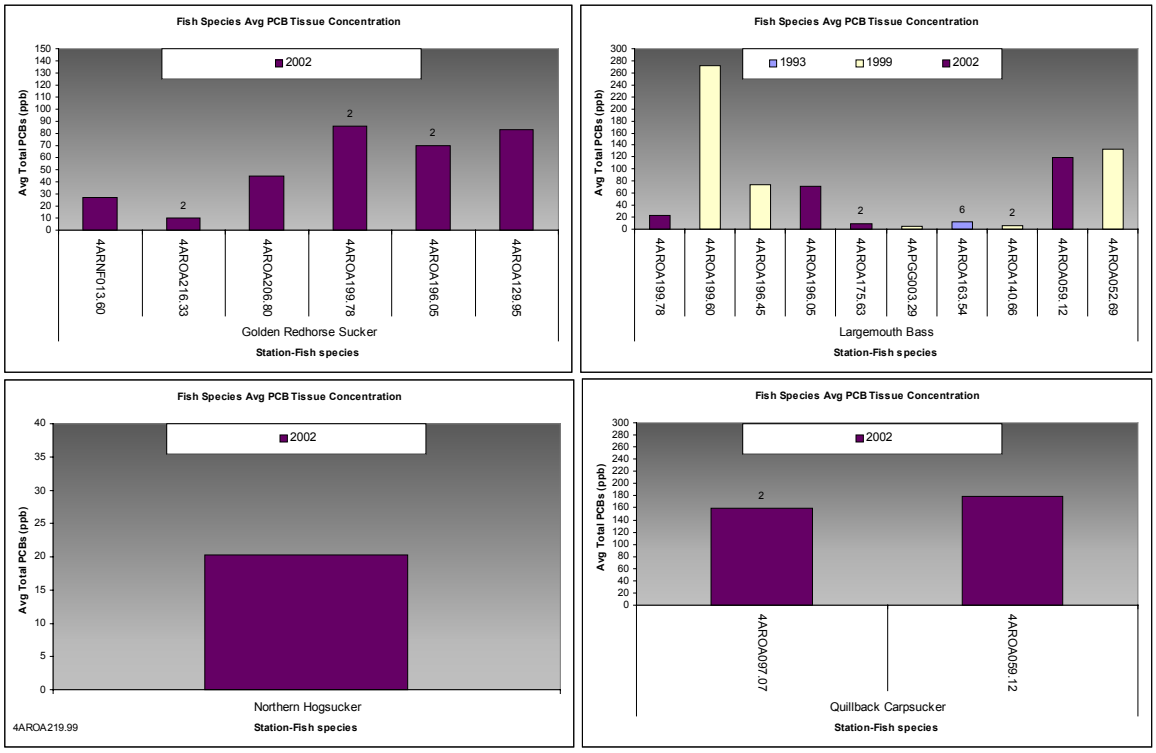

Figure 4.10 Individual fish species PCB results: Golden Redhorse Sucker, Largemouth Bass, Northern Hogsucker, Quillback Carpsucker

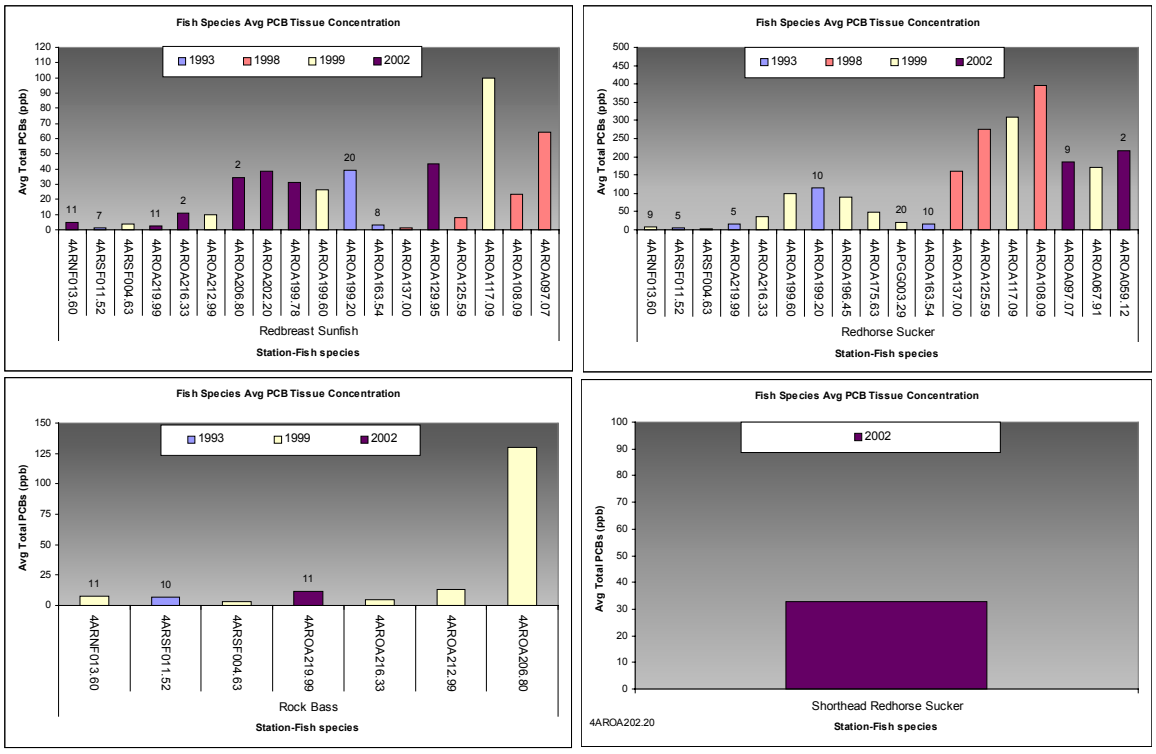

Figure 4.11 Individual fish species PCB results: Redbreast Sunfish, Redhorse Sucker, Rock Bass, Shorthead Redhorse Sucker

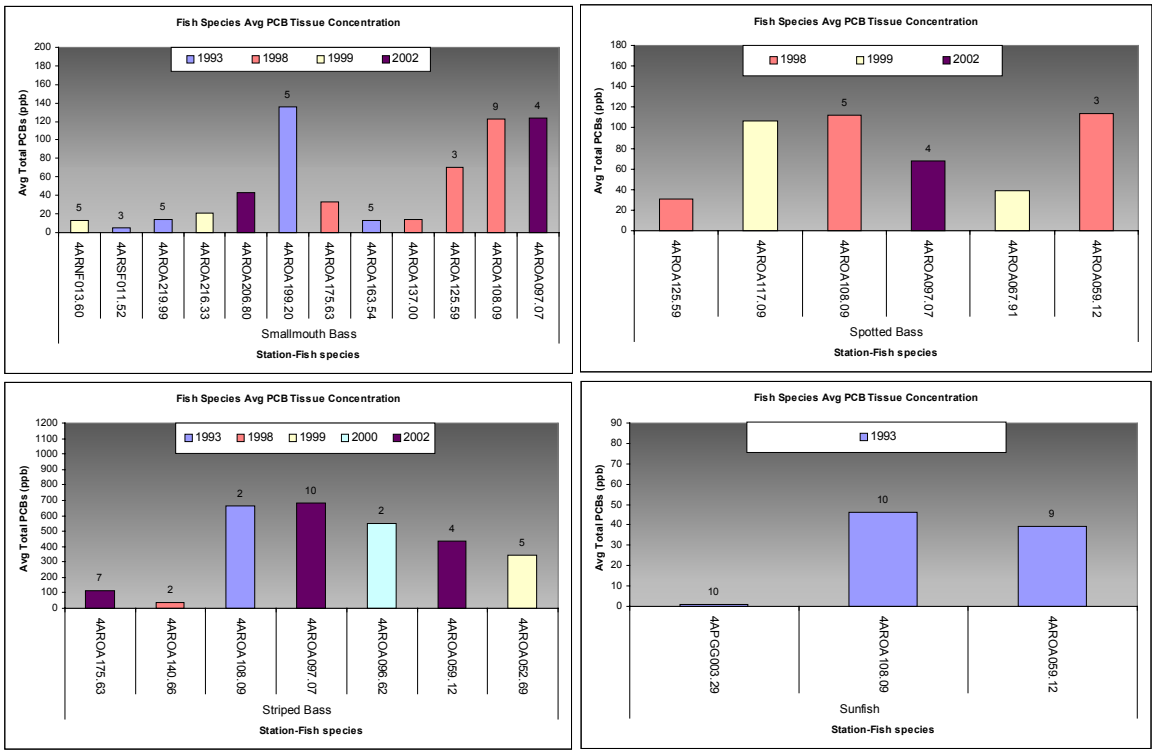

Figure 4.12 Individual fish species PCB results: Smallmouth Bass, Spotted Bass, Striped Bass, Sunfish

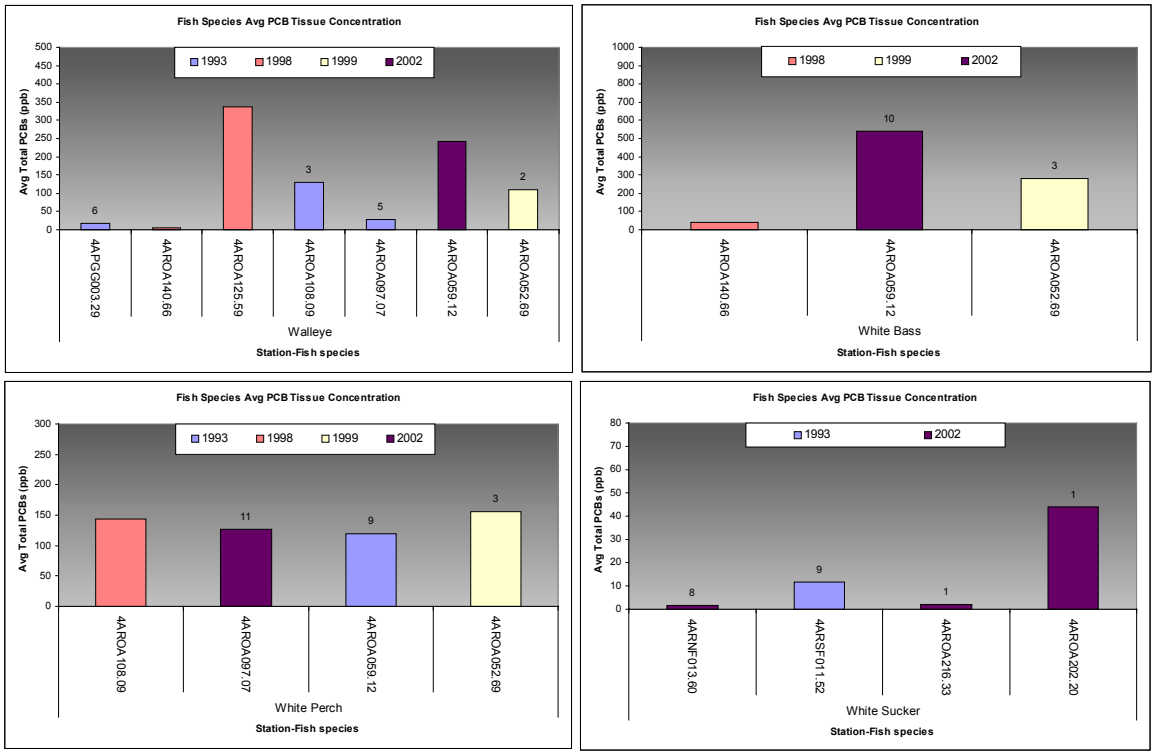

Figure 4.13 Individual fish species PCB results: Walleye, White Bass, White Perch, White Sucker

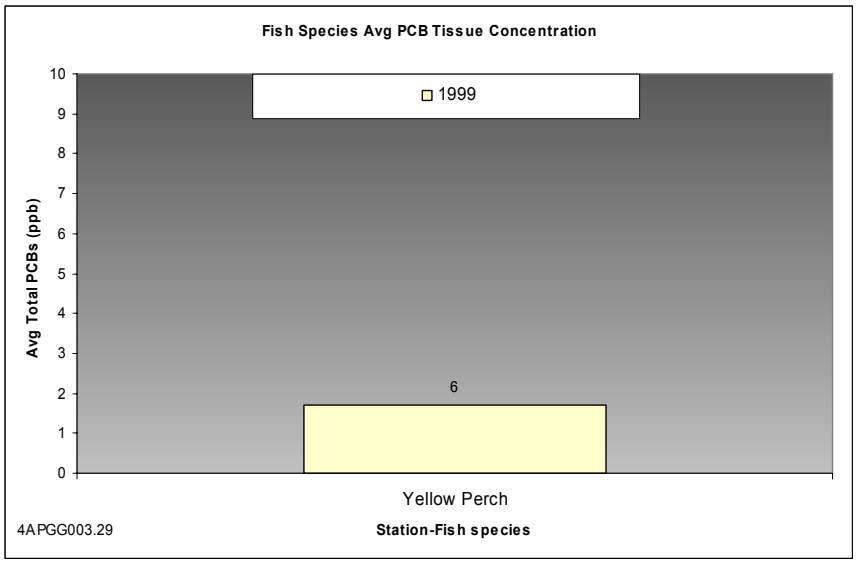

Figure 4.14 Individual fish species PCB results: Yellow Perch

Fish Tissue Data Analysis Notes:

Upper Roanoke Segment (headwaters to Niagara backwaters)

- Carp had the highest average PCB concentrations
- In general, average PCB concentration levels are higher at stations located further downstream
- Higher PCB levels were noted downstream of Peters Creek for the following species: Black jumprock sucker, golden redhorse sucker, white sucker, carp, redbreast sunfish, rock bass, and smallmouth bass
- Increasing concentration was not due to temporal variation in the data collected, as evidenced by the 1999 data collections for rock bass and black jumprock suckers.
- Average PCB concentrations exceeded the DEQ impairment threshold (54 ppb) at stations 4AROA216.33, 4AROA206.80 (rock bass), 4AROA199.78 (redhorse sucker and golden redhorse sucker). Fish tissue concentrations for carp exceeded the DEQ threshold at each of these stations.

Middle Roanoke Segment (Niagara backwaters downstream to Leesville Dam)

- Flathead catfish, carp, and gizzard shad had the highest average PCB concentrations
- Average concentration exceeded the DEQ threshold at individual stations for all species, except yellow perch, walleye, channel catfish, and all sunfish species.
- Stations located upstream of Niagara dam (backwaters area) and downstream of Tinker Creek had the highest average PCB concentration (stations 4AROA199.60, 4AROA199.20, 4AROA106.05, and 4AROA196.45). This may be a depositional area with high PCBs in sediment.
- Striped bass had the highest average concentration at station 4AROA175.63 (Smith Mountain Lake)

Lower Roanoke Segment (Leesville Dam downstream to Kerr Reservoir)

- The highest average PCB concentrations in the Roanoke River Basin were noted for lower Roanoke stations.
- The majority of fish species had average concentrations greater than the DEQ impairment threshold. Sunfish species had the lowest concentrations overall.
- Carp, channel catfish, flathead catfish, gizzard shad, and sucker species had the highest PCB concentrations.

- Station 4AROA108.09 (below Seneca Creek) recorded the highest PCB concentrations.
- An increasing trend for was observed for stations 4AROA125.59 and 4AROA108.09 (near Long Island) downstream of Altavista.
- Lower concentrations were noted at Station 4AROA097.07, except for striped bass

4.6 Sediment PCB Results

Sediment samples were collected and analyzed by DEQ under the Fish Tissue and Sediment Monitoring Program. These data were compiled and summarized in order to help identify spatial and temporal trends that will assist in the identification of potential PCBs sources in the Roanoke River Basin. PCBs are hydrophobic and typically adsorb to sediment particles, which are transported into streams and rivers through erosion, stormwater runoff, and other processes. Although the instream transport of sediment can cause uncertainty as to the source of contamination, its movement is relatively predictable and the presence of PCBs can be assumed to be an indicator of an upstream source (active or legacy). Dams, depositional zones, and other stream characteristics should be considered in the analysis of sediment PCB data.

Sediment PCB results are shown using graduated symbols in Figure 4.15. These symbols vary in size according to the average total PCB concentration observed in sediment samples collected and analyzed for the entire sampling period at each monitoring station. The data intervals shown in the legend correspond with the sediment quality guidelines including the freshwater consensus-based Probable Effects Concentration (PEC) (676 ppb) and NOAA's Effects Range-Median screening value (180 ppb), which was also used for comparison purposes.

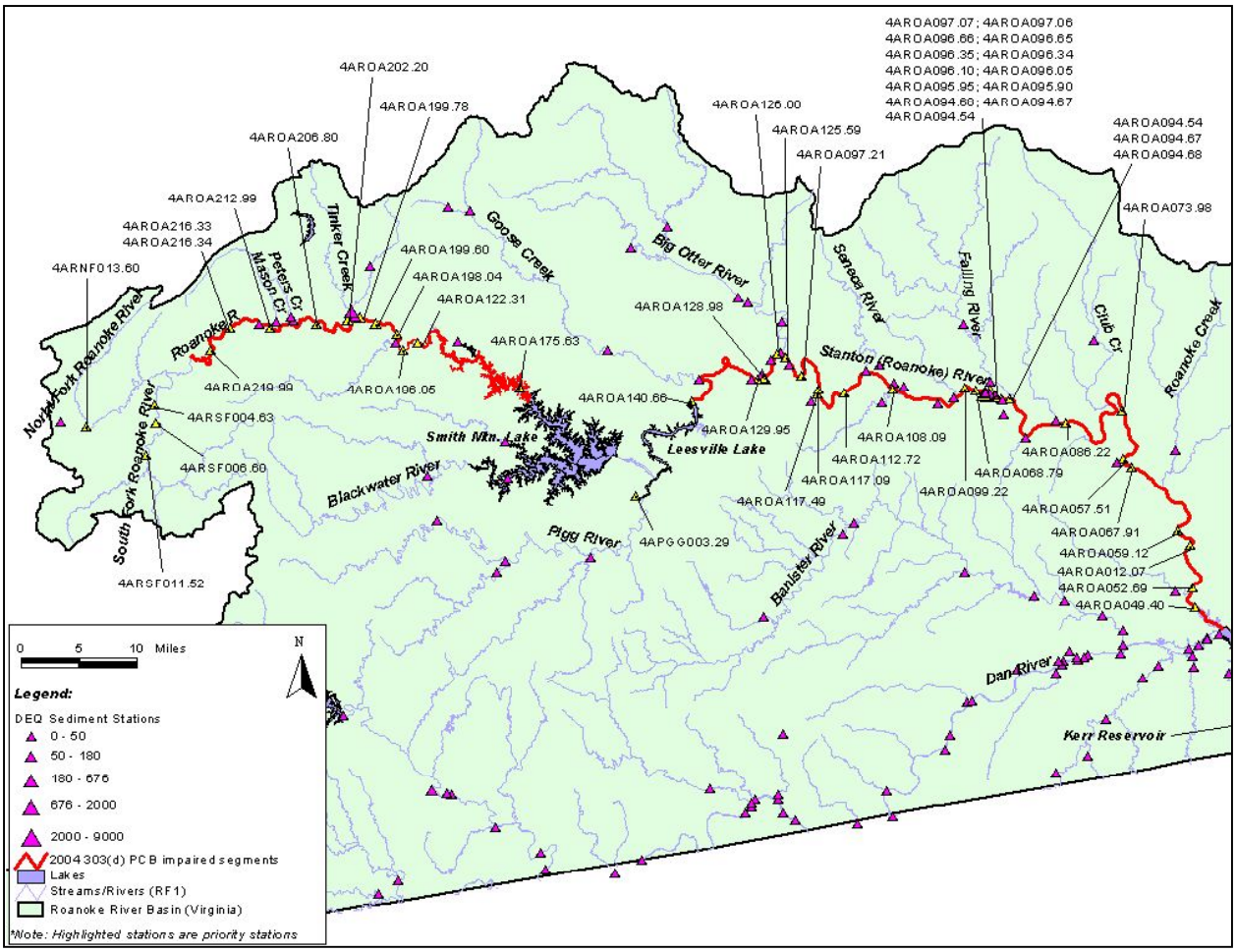

Figure 4.15 Sediment PCB results (average total PCB concentration, period of record)

Sediment total PCB concentrations for priority monitoring stations located in the Upper and Middle Roanoke regions are presented in Figure 4.16. Lower Roanoke average sediment concentrations are presented in Figure 4.17. All sampling dates are shown in each graph; therefore, each data point represents one observation. Stations are presented in an upstream – downstream progression for spatial analysis purposes, according to station river-mile code. Sediment PCB screening values are shown for comparison: The freshwater consensus-based PEC (676 ppb), NOAA Effects Range-Low (ER-L, 22.7 ppb), and NOAA Effects Range-Median (ER-M, 180 ppb). These data are also presented in Tables 4.9 and 4.10.

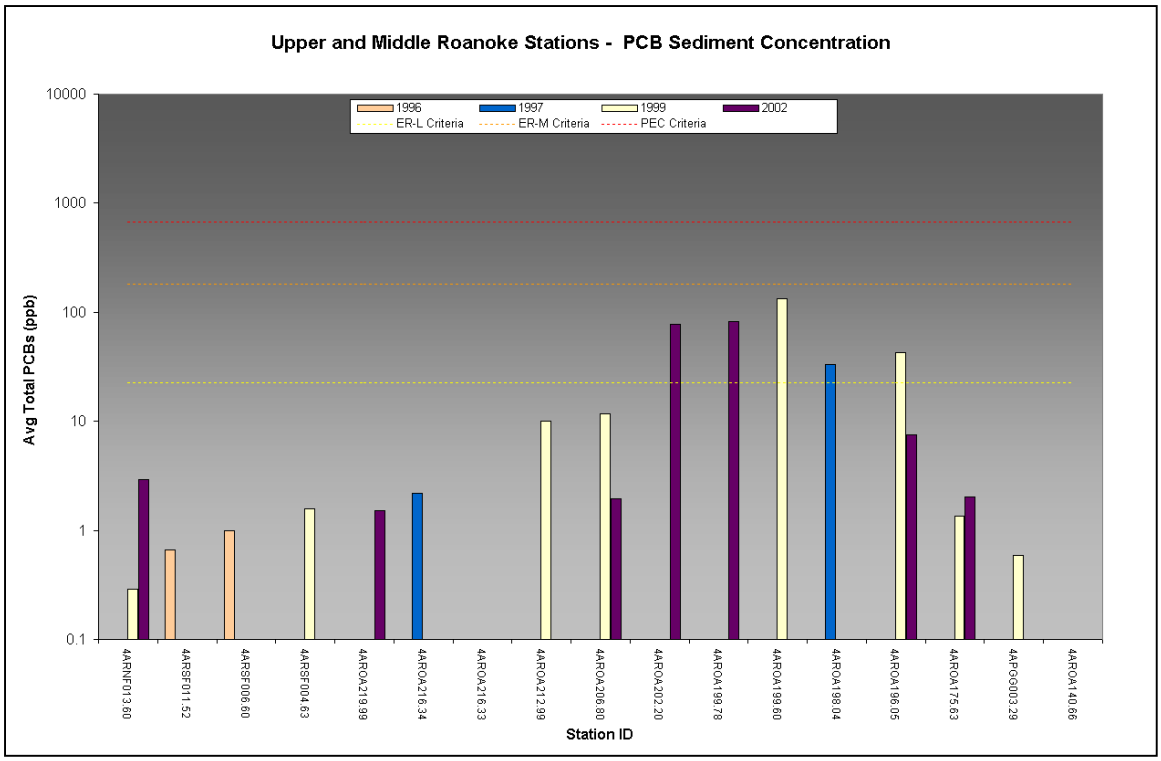

Figure 4.16 Upper and Middle Roanoke – Sediment PCB Results (all sample dates shown, log scale)

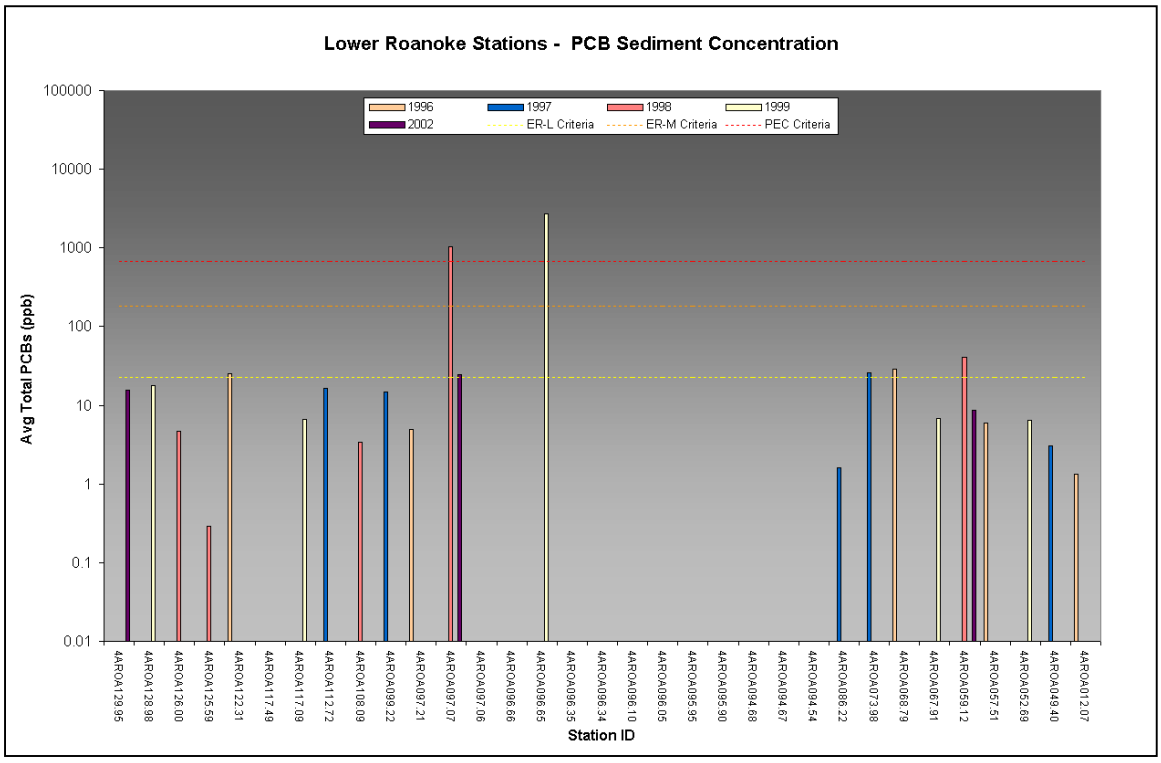

Figure 4.17 Lower Roanoke – Sediment PCB Results (all sample dates shown, log scale)

Table 4.9 Upper and Middle Roanoke – Sediment PCB results by sample year

Upper and Middle Roanoke	Average Total PCB (ppb (dry weight basis))			
	Sampling Year			
DEQ Site	1996	1997	1999	2002
4ARNF013.60			0.292	2.937
4ARSF011.52	0.660			
4ARSF006.60	1.000			
4ARSF004.63			1.571	
4AROA219.99				1.526
4AROA216.34		2.193		
4AROA216.33				
4AROA212.99			9.977	
4AROA206.80			11.650	1.936
4AROA202.20				77.835
4AROA199.78				81.868
4AROA199.60			133.375	
4AROA198.04		33.099		
4AROA196.05			42.986	7.516
4AROA175.63			1.339	2.041
4APGG003.29			0.595	
4AROA140.66				

Table 4.10 Lower Roanoke – Sediment PCB results by sample year

Lower Roanoke	Average Total PCB (ppb (dry weight basis))				
	Sampling Year				
DEQ Site	1996	1997	1998	1999	2002
4AROA129.95					15.619
4AROA128.98				17.948	
4AROA126.00			4.710		
4AROA125.59			0.290		
4AROA122.31	25.090				
4AROA117.49		0.000			
4AROA117.09				6.689	
4AROA112.72		16.605			
4AROA108.09			3.438		
4AROA099.22		14.722			
4AROA097.21	4.920				
4AROA097.07			1021.404		24.441
4AROA097.06					
4AROA096.66					
4AROA096.65				2730.000	
4AROA096.35					
4AROA096.34					
4AROA096.10					
4AROA096.05					
4AROA095.95					
4AROA095.90					
4AROA094.68					
4AROA094.67					
4AROA094.54					
4AROA086.22		1.621			
4AROA073.98		26.182			
4AROA068.79	28.430				
4AROA067.91				6.806	
4AROA059.12			40.801		8.672

Lower Roanoke	Average Total PCB (ppb (dry weight basis))				
	Sampling Year				
DEQ Site	1996	1997	1998	1999	2002
4AROA057.51	5.950				
4AROA052.69				6.400	
4AROA049.40		3.038			
4AROA012.07	1.320				

Sediment Data Analysis Notes:

Upper/Middle Roanoke (headwaters downstream to Leesville Dam)

- Average sediment PCB concentrations did not exceed the EPA threshold value of 676 ppb.
- The highest average concentrations were observed at stations 4AROA199.60 (Niagara backwaters), 199.78 (below Tinker Creek mouth), and 4AROA202.20 (above Tinker Creek mouth and downstream of Peters Creek)
- An increasing trend in average PCB concentration was noted downstream of Peters Creek at station 4AROA206.80
- Sediment concentrations decrease downstream of Smith Mountain Lake in the Upper/Middle Roanoke segment.

Lower Roanoke (Leesville Dam downstream to Kerr Reservoir)

- Consensus-based PEC exceedances were recorded at stations 4AROA097.07 and 4AROA096.65.
- Average sediment PCB concentrations were lower at stations located below Altavista. These data do not correspond with high fish tissue concentrations that were observed at these stations (e.g. 4AROA108.09).

4.7 Water Column PCB Results

Water quality monitoring stations with PCB data in the Roanoke River Basin are shown in Figures 4.18 and 4.19. Priority stations are highlighted in yellow. The larger symbols in these figures denote stations with PCB congener data (Figure 4.18) and stations with total PCB observations (Figure 4.19). None of the stations with PCB Aroclor data recorded concentrations above the laboratory detection limit of 0.1 µg/l. Of the 34 stations with total PCB data, only three stations recorded observations above the laboratory detection limit: 4ABLE000.00 (0.3 µg/l) 4AROA036.56 (0.7 µg/l) 4AROA046.34 (3.0 µg/l). All three stations are located in Kerr Reservoir.

Priority stations with PCB congener data are listed in Table 4.11.

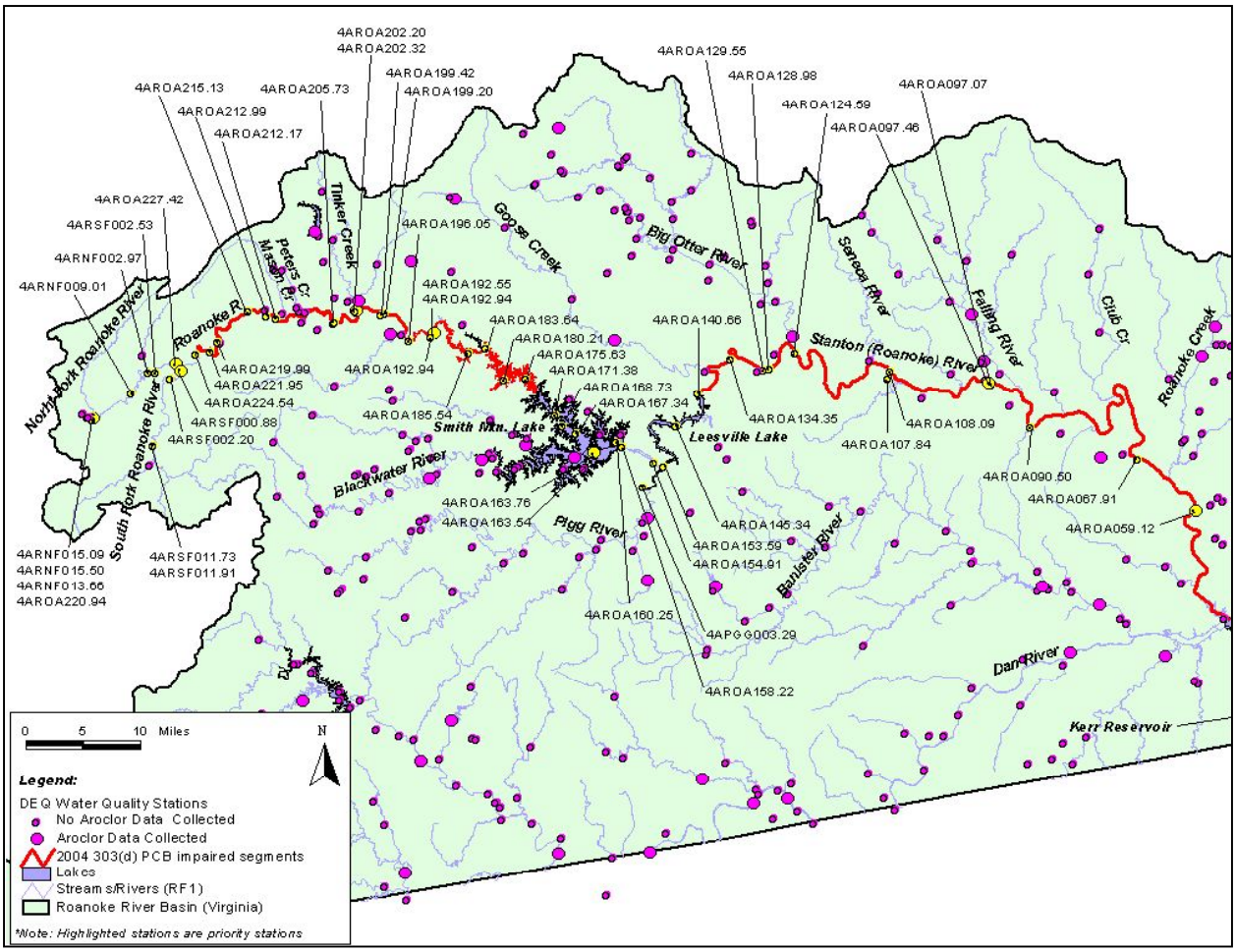

Figure 4.18 Water quality monitoring stations: Aroclor-specific PCB data collected

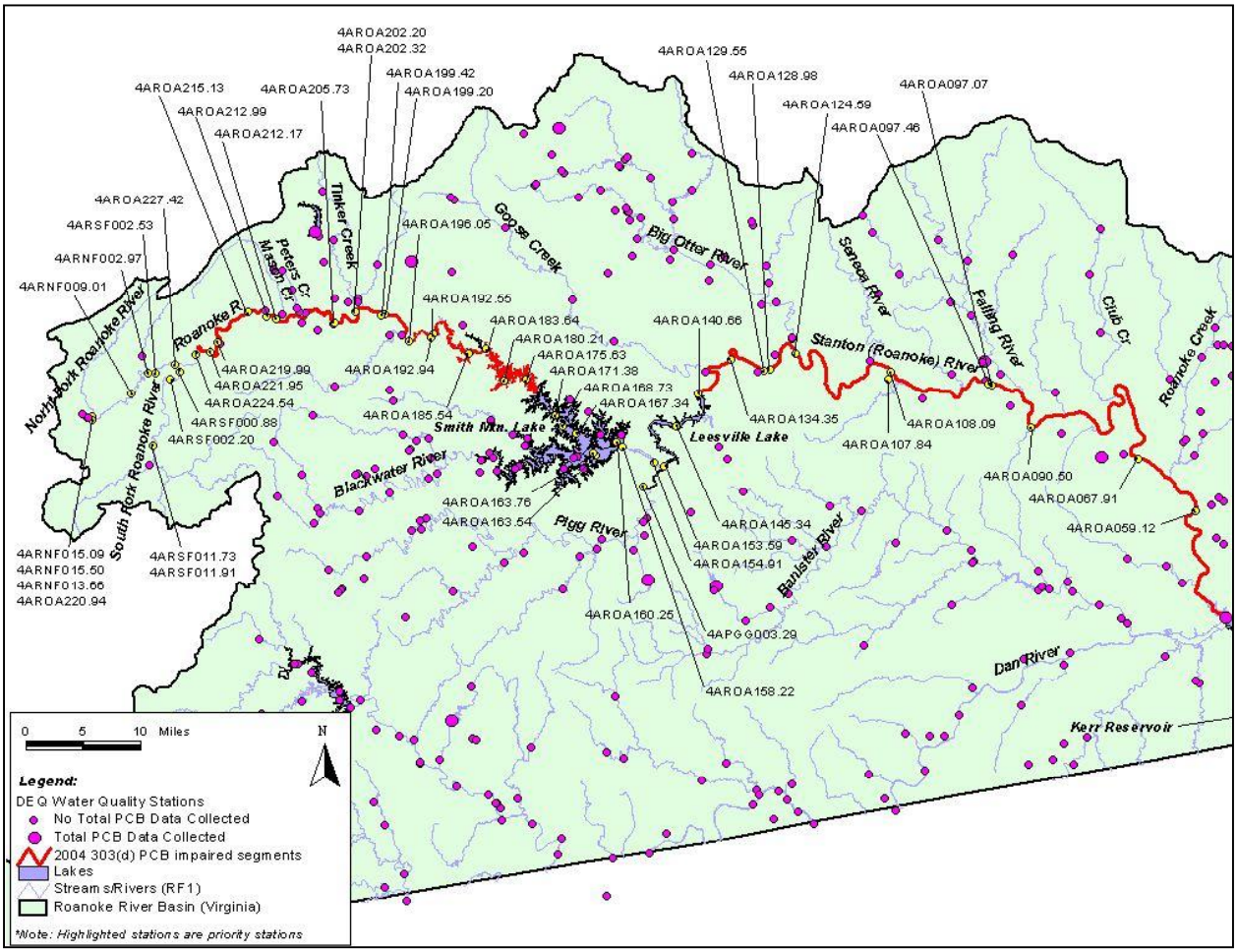

Figure 4.19 Water quality monitoring stations: Total PCB data collected

Table 4.11 Water quality monitoring stations with PCB Aroclor data

			PCB Aroclors Sampled							
DEQ Site	Segment Location	Sample Date	PCB 1016	PCB 1221	PCB 1232	PCB 1242	PCB 1248	PCB 1254	PCB 1260	Total PCBs
4ARNF013.66	Upper Roanoke	10/29/1984	0.1	0.1	0.1	0.1	0.1	No Data	0.1	No Data
4ARSF000.88	Upper Roanoke	10/29/1984	0.1	0.1	0.1	0.1	0.1	No Data	0.1	No Data
4AROA227.42	Upper Roanoke	10/29/1984	0.1	0.1	0.1	0.1	0.1	No Data	0.1	No Data
4AROA202.20	Upper Roanoke	10/22/1984	0.1	0.1	0.1	0.1	0.1	No Data	0.1	No Data
4AROA192.55	Middle Roanoke	10/22/1984	0.1	0.1	0.1	0.1	0.1	No Data	0.1	No Data
4AROA163.76	Middle Roanoke	9/14/1987	0.1	0.1	0.1	0.1	0.1	No Data	0.1	No Data
4AROA097.46	Lower Roanoke	10/15/1984	0.1	0.1	0.1	0.1	0.1	No Data	0.1	No Data
4AROA097.46	Lower Roanoke	7/15/1985	0.1	0.1	0.1	0.1	0.1	No Data	0.1	No Data
4AROA059.12	Lower Roanoke	3/19/1985	0.1	0.1	0.1	0.1	0.1	No Data	0.1	No Data

5. Source Assessment

This section presents the information collected to date on potential point and nonpoint sources of PCBs in the Roanoke River basin. A wide range of information was accessed to help identify potential PCB sources in the watershed, including DEQ monitoring data and special studies, the Toxic Substance Control Act (TSCA) database, the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) database, EPA Superfund data, the Resource Conservation and Recovery Act (RCRA) database, and other readily available information. Additional source assessment information will be obtained in collaboration with EPA and DEQ through the review of solid waste facility data, DEQ pollution complaint records, VPDES facility information, and the collection of additional monitoring data at selected stations. A PCB monitoring plan will be developed in the next phase of the TMDL study in order to identify active and legacy sources of PCB contamination in the watershed.

5.1 Known Sources

DEQ has conducted several special studies in recent years to assess the spatial extent of PCB contamination and identify sources of PCB contamination. Much of the source identification work to date has centered on the Staunton (Roanoke) River impairment/fish consumption advisory segments. BGF Industries was identified a source of legacy PCB contamination in special studies conducted by DEQ in the late 1990s. BGF Industries has two manufacturing plants located in Alta Vista, Virginia. These facilities are characterized as a Specialty Weaving Plant and Industrial Non-Woven facility that specialize in the manufacture of composite fabrics.

As part of an investigation into the level of PCB contamination on and around the BGF Industries site, soil and water samples were taken and analyzed by BGF Industries and presented to VADEQ. Presented in Tables 5.1 through 5.4 are the preliminary results of the company's investigation of PCB contamination at and adjacent to the facilities. Results include analyses of soil, subsoil, ground water, sediment and surface water samples.

Table 5.1 BGF Industries PCB sampling results

PCB SAMPLING RESULTS FROM AREA OF BGF INDUSTRIES SITE, ALTAVISTA, VA.														
	Samples collected 10/7/1999													
	Background	Sanitary Sewer*	Manhole near ravine	Junction Box	Edge of concrete pad	Soil	Ravine mouth surface	Same Location as SD801S (2-6 in. depth)	Sediment in mouth of storm line**	Same location as SD802S (2-6 in. depth)	24 ft. down stream from culvert mouth	Same locations as SD803S (1-10 in. depth)	3 ft. left of SD803B	Same location as SD804S (3-6 in. depth)
Station ID	SD101	SD201	SD301	SD401	SD501	SD601	SD801S	SD801B	SD802S	SD802B	SD803S	SD803B	SD804S	SD804B
Total PCBs (ppb)	<60	5.2	4700	32570	34450	61270	130100	184540	135960	697460	3072750	860160	114490	23270

*The sanitary sewer sample is the only water sample in these results. All other samples are from soils and sediments on an adjacent to the BGF site.

**This figure was revised 1/13/2000 after re-analysis of initial data.

Table 5.2 BGF Industries PCB soil/sediment final analysis – Part 1

Final analysis of soil samples from Altavista/Hurt area													
	Altavista STP 17	STP 17 dup.	Altavista STP 16	Hardy Texaco	Hardy Texaco	Watts Chevron	Watts Chevron	Lynch Cr.	Blanks Exoon	Lynch Cr.	Lynch Cr.	Lynch Cr.	Lynch Cr.
Units	PPB	PPB	PPB	PPB	PPB	PPB	PPB	PPB	PPB	PPB	PPB	PPB	PPB
PCB1	<1	<1	106	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB5	1177	2259	3596	54	3	<1	6	<1	<1	<1	<1	1	<1
PCB18	8345	16479	25263	61	3	<1	<1	<1	<1	30	1	<1	2
PCB31	15869	21311	23834	106	<1	<1	2	2	2	65	1	13	9
PCB44	12073	13588	12724	106	4	11	<1	1	1	65	1	<1	11
PCB52	12825	22880	25632	91	2	1	<1	<1	1	74	1	13	11
PCB66	15424	18502	20699	226	3	10	21	1	2	104	1	17	14
PCB87	3591	6980	12539	<1	1	4	<1	<1	<1	30	<1	3	4
PCB101	5711	11234	19270	21	1	3	42	1	<1	40	1	7	6
PCB110	7524	14331	16043	122	2	18	12	1	1	55	1	7	8
PCB138	1693	3056	5624	<1	<1	22	13	<1	<1	20	<1	27	<1
PCB141	325	578	1060	61	<1	5	1	<1	<1	4	<1	<1	<1
PCB151	1727	3345	5901	<1	<1	<1	<1	<1	<1	<1	<1	2	2
PCB153	1163	1982	3550	35	<1	4	3	<1	<1	10	1	1	2
PCB170	164	454	830	24	2	<1	1	1	<1	<1	<1	1	<1
PCB180	298	537	968	122	<1	2	2	2	<1	3	1	1	1
PCB183	113	186	323	<1	<1	1	<1	<1	<1	3	<1	1	<1
PCB187	195	330	553	6	<1	<1	<1	<1	<1	4	<1	1	1
PCB206	236	330	429	99	1	<1	1	1	<1	35	<1	<1	<1
Total Target Congeners	88453	138362	178944	1134	22	81	104	10	7	542	9	95	71
Total Other Congeners	175000	313000	422000	10000	3000	1000	1600	220	220	650	2900	760	490
Total PCBs	263453	451362	600944	11134	3022	1081	1704	230	227	1192	2909	855	561

Table 5.3 BGF Industries PCB soil/sediment final analysis – Part 2

Final analysis of soil samples from Altavista/Hurt area									
	Schrader 24	Schrader 25	Schrader 26	Schrader 27	A. O. Smith	Wreck site 20	Wreck site 21	English 18	English 19
Units	PPB	PPB	PPB	PPB	PPB	PPB	PPB	PPB	PPB
PCB1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB5	<1	<1	<1	<1	3	<1	<1	<1	5
PCB18	<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB31	1	<1	<1	<1	<1	<1	<1	<1	<1
PCB44	3	<1	<1	<1	<1	<1	<1	<1	<1
PCB52	4	<1	<1	<1	<1	<1	<1	<1	2
PCB66	6	1	<1	1	2	<1	<1	<1	<1
PCB87	3	<1	<1	1	8	<1	<1	<1	<1
PCB101	6	1	<1	1	53	<1	<1	<1	<1
PCB110	8	1	<1	1	30	<1	<1	<1	2
PCB138	16	1	<1	1	110	<1	<1	1	6
PCB141	<1	<1	<1	<1	66	<1	<1	<1	<1

Final analysis of soil samples from Altavista/Hurt area									
	Schrader 24	Schrader 25	Schrader 26	Schrader 27	A. O. Smith	Wreck site 20	Wreck site 21	English 18	English 19
Units	PPB	PPB	PPB	PPB	PPB	PPB	PPB	PPB	PPB
PCB151	<1	<1	<1	<1	83	<1	<1	<1	1
PCB153	2	1	<1	<1	116	<1	<1	<1	<1
PCB170	1	<1	<1	<1	105	<1	<1	<1	<1
PCB180	<1	<1	<1	<1	96	<1	<1	<1	1
PCB183	<1	<1	<1	<1	72	<1	<1	<1	<1
PCB187	<1	<1	<1	<1	96	<1	<1	<1	<1
PCB206	<1	<1	<1	<1	23	<1	<1	<1	<1
Total Target Congeners	50	5	<1	5	863	<1	<1	1	17
Total Other Congeners	730	140	<1	32	8500	<1	<1	25	250
Total PCBs	780	145	<1	37	9363	<1	<1	26	267

*All soil and sediment samples.

Table 5.4 BGF Industries PCB soil/sediment final analysis – Part 3

Final analysis of soil samples from Altavista/Hurt area											
	Burlington 31	Burlington 32	Burlington 32A	Burlington 32A dup.	Burlington 33	Burlington 34	Lane 1	Lane 4	Lane 5	Lane 6	Lane 7
Units	PPB	PPB	PPB	PPB	PPB	PPB	PPB	PPB	PPB	PPB	PPB
PCB1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB5	<1	1	1	<1	<1	1	225	<1	4	<1	<1
PCB18	<1	2	<1	<1	<1	2	<1	<1	4	<1	20
PCB31	<1	10	<1	<1	<1	10	1118	<1	7	<1	2
PCB44	<1	7	1	1	<1	7	415	5	8	77	80
PCB52	<1	7	1	1	<1	7	409	1	10	7	11
PCB66	<1	16	2	2	<1	18	605	<1	17	11	98
PCB87	<1	6	1	1	<1	6	69	<1	8	<1	17
PCB101	<1	11	2	2	<1	11	115	<1	9	<1	69
PCB110	<1	13	2	2	<1	13	133	<1	12	<1	<1
PCB138	<1	25	2	2	<1	25	29	1	7	<1	100
PCB141	<1	7	<1	<1	<1	7	17	<1	5	<1	59
PCB151	<1	7	<1	<1	<1	7	<1	<1	<1	<1	83
PCB153	<1	24	2	1	<1	24	31	1	6	<1	105
PCB170	<1	10	<1	<1	<1	10	23	<1	5	<1	66
PCB180	<1	23	<1	<1	<1	23	9	<1	6	<1	89
PCB183	<1	6	<1	<1	<1	6	6	<1	6	<1	44
PCB187	<1	11	<1	<1	<1	11	12	<1	20	<1	77
PCB206	<1	<1	<1	<1	<1	<1	86	<1	<1	<1	5
Total Target Congeners	<1	186	14	12	<1	188	3302	8	134	95	925
Total Other Congeners	<1	1100	114	120	<1	1100	12000	390	200	100	3700
Total PCBs	<1	1286	128	132	<1	1288	15302	398	334	195	4625

5.2 Nonpoint Sources

Nonpoint source loading of pollutants results from the transport of pollutants into receiving waters via landscape runoff processes, including overland and subsurface flow. Nonpoint sources of PCBs can be grouped most appropriately into nonpoint source media: washoff from land surfaces, and streambed sediments. Atmospheric deposition (wet/dry deposition) is also a potential nonpoint source of PCBs.

5.2.1 Washoff from Land surfaces

There are no natural sources of PCBs, however, PCBs can be found in many environments as a result of fires, historical spills, and airborne transportation of contaminated dust (atmospheric deposition). Usually, these PCB concentrations are well below EPA's action level of 1 ppm in soils. Because PCBs are generally found in cooling oils, the affinity of PCBs for water is very low (USGS, 1995).

PCBs have a high sorption factor for solids and fatty animal tissue. In the case of a fire, for example, PCBs can sorb onto smoke and ash particles and be scattered by the wind. PCBs from spills tend to remain in the area adjacent to the spill by sorbing to soil particles. These contaminated soils can then be transported through precipitation and overland flow to stream systems. Additional sampling in the Roanoke River may help identify additional nonpoint sources.

5.2.2 Streambed Sediments

When PCBs spill and sorb onto the soil, there is a potential for stream contamination when precipitation washes the contaminated soil into the stream. The affinity of PCBs for soil would limit the effectiveness of groundwater seepage as a mode of transport. Discharges of PCBs directly into the stream can also result in sediment and stream bank contamination. The PCBs in discharges sorb onto the soils on the stream banks and onto the sediments downstream of the discharge point. Stream bank erosion deposits the contaminated soils in the streambed.

Contaminated streambed sediments are available for consumption by the aquatic biota (through dissolved particles or resuspended particles), are transported downstream, or are buried under additional sediments. The transport can result in the sediment being flushed out of the system or being trapped behind downstream dams. Existing PCB projects such as the Hudson River project in New York and the Housatonic River project in Massachusetts have found that historical discharges have resulted in sediment contamination and that the contaminated soils tend to collect in slow river stretches or reservoirs. The contaminated soils remain there until they are dredged or dislodged by storms.

The sorption of PCBs onto sediment represents a critical mechanism for uptake into the food chain. Fish and benthic organisms are exposed to and accumulate PCBs from the water, through contact with and ingestion of sediments, and from the food they eat. Bottom-feeding fish like carp accumulate high concentrations because of their consumption of contaminated detritus and sediments. As bigger fish or mammals eat smaller contaminated fish, the PCBs bioaccumulate in the fatty tissues. When the animals die, the accumulated PCBs are released to the soil or water. Migration of fish from contaminated areas to clean areas can spread PCBs into new areas. Tissue concentrations vary based on the animal‘s travel range, age, weight, and diet. Concentrations are extremely variable even within the same species and at the same location.

5.3 Point Sources

Point sources are defined in the Clean Water Act as any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container,

rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharged. Potential PCB point sources may include landfill sites, industrial discharges, municipal discharges, and other sources.

Because PCBs are no longer manufactured or used in industrial processes, potential PCB point sources are restricted to sites where PCBs were historically located onsite. Currently, BGF Industries is the only known point source of PCB contamination in the watershed.

The DEQ Office of Waste Programs maintains an inventory of all active solid waste facilities in Virginia. The DEQ West Central and South Central Regional Offices oversee all solid waste sites in the Roanoke River Basin. Table 5.5 presents the names and locations of active and inactive solid waste facilities located in counties within the Roanoke River Basin. Additional data on landfill sites and other potential PCB sources in the watershed will be collected in collaboration with DEQ.

Table 5.5 Solid waste facilities permitted by DEQ (all facilities may not be located within the Roanoke River Basin)

Solid Waste Facilities in Watershed Counties - VADEQ South Central Regional Office					
Facility Name	**Permit Number**	**Facility Type**	**Year Permitted**	**County**	**Status**
Altavista Sanitary Landfill	043	Sanitary Landfill	1972	Campbell	Closed
Babcock & Wilcox Landfill	217	Captive Industrial Landfill	1977	Campbell	Inactive
Babcock & Wilcox Landfill	202	Captive Industrial Landfill	1976	Campbell	Closed
Baskerville Correctional Unit	PBR299	RMW Storage Only	NA	Mecklenburg	PBRs Prior to 1994
Baskerville Correctional Unit #4	PBR300	RMW Steam Sterilization	NA	Mecklenburg	PBRs Prior to 1994
Burlington Ind. - Mecklenburg	024	MSW Incineration-RDF Facility	1972	Mecklenburg	Closed
Burlington Ind. Landfill	260	Captive Industrial Landfill	1978	Mecklenburg	Closed
Burlington Ind. Landfill	277	Captive Industrial Landfill	1979	Mecklenburg	Never Operated/Const
Campbell # 1	168	Sanitary Landfill	1974	Campbell	Closed
Campbell County Sanitary Landfill	285	Sanitary Landfill	1979	Campbell	Active
Campbell County Sanitary Landfill	009	Sanitary Landfill	1971	Campbell	Closed
Campbell County- Carwile Sanitary Landfill	081	Sanitary Landfill	1973	Campbell	Closed
Charlotte County Sanitary Landfill	101	Sanitary Landfill	1973	Charlotte	Closed
Chase City Sanitary Landfill	025	Sanitary Landfill	1972	Mecklenburg	Inactive
Chatham Correctional Unit #15	PBR341	RMW Steam Sterilization	NA	Pittsylvania	PBRs Prior to 1994
Chatham Sanitary Landfill	127	Sanitary Landfill	1974	Pittsylvania	Closed
City of Danville Transfer Station	PBR015	Transfer Station	1993	Danville	Active
City of Danville YWCF	PBR010	Yard Waste Composting Facilit	1992	Danville	Active
Clarksville Demo Landfill	284	C/D/D Landfill	1979	Mecklenburg	Closed
Community Memorial Health Center	PBR301	RMW Storage Only	NA	Mecklenburg	PBRs Prior to 1994
Cycle Systems Landfill	432	C/D/D Landfill	1983	Campbell	Closed
Danville Regional Medical Center	PBR148	RMW Incineration	1998	Danville	Closed
Danville Sanitary Landfill	122	Sanitary Landfill	1974	Danville	Closed
Dept. of Mental Health - Southern VA. MH INST.	PBR240	RMW Storage Only	NA	Danville	PBRs Prior to 1994
First Piedmont Corp. - Martinsville Landfill	065	Non-Captive Industrial Landfi	1972	Pittsylvania	Active
Halifax Correctional Unit # 23	PBR273	RMW Steam Sterilization	NA	Halifax	PBRs Prior to 1994
Halifax County Sanitary Landfill	092	Sanitary Landfill	1973	Halifax	Active
Halifax County Waste Transfer Station	PBR020	Transfer Station	NA	Halifax	Closed
Halifax South Boston Community Hospital	PBR389	RMW Storage Only	NA	South Boston	PBRs Prior to 1994
Lynchburg Foundry - Lynchburg Landfill	456	Captive Industrial Landfill	1984	Campbell	

Solid Waste Facilities in Watershed Counties - VADEQ South Central Regional Office					
Facility Name	**Permit Number**	**Facility Type**	**Year Permitted**	**County**	**Status**
Lynchburg Foundry, A Mead Comp.	106	Sanitary Landfill	1973	Campbell	Never Operated/Const
Mecklenburg Correctional Center	PBR302	RMW Steam Sterilization	NA	Mecklenburg	PBRs Prior to 1994
Mecklenburg County Sanitary Landfill	014	Sanitary Landfill	1972	Mecklenburg	Active
Mecklenburg County YWCF	PBR011	Yard Waste Composting Facilit	1992	Mecklenburg	Inactive
Memorial Hospital of Danville	PBR239	RMW Incineration	NA	Danville	Closed
MORRIS, K. W., DDS, LTD.	PBR298	RMW Storage Only	NA	Mecklenburg	PBRs Prior to 1994
Mt. Athos - Griffin Pipe Landfill	559	Captive Industrial Landfill	1993	Campbell	Never Operated/Const
Pittsylvania County Sanitary Landfill	152	Sanitary Landfill	1974	Pittsylvania	Closed
Pittsylvania County Sanitary Landfill	571	Sanitary Landfill	1994	Pittsylvania	Active
Pittsylvania County Sanitary Landfill	512	Sanitary Landfill	1987	Pittsylvania	Closed
Rustburg Correctional Unit # 9	PBR220	RMW Steam Sterilization	NA	Campbell	Closed
South Boston Sanitary Landfill	031	Sanitary Landfill	1972	South Boston	Active
South Boston Sanitary Landfill	321	Sanitary Landfill	1980	South Boston	Closed
South Hill Demo Landfill	283	C/D/D Landfill	1979	Mecklenburg	Inactive
Unitized Sys Co. Landfill	069	Captive Industrial Landfill	1973	Mecklenburg	Never Operated/Const
Unitized Systems County	056	Sanitary Landfill	1972	Mecklenburg	Never Operated/Const

Solid Waste Facilities in Watershed Counties - VADEQ West Central Regional Office				
Facility Name	**Permit Number**	**Facility Type**	**Year Permitted**	**County**
Bedford County Sanitary Landfill	560	Sanitary Landfill	1993	Bedford
Bedford County Transfer Station	PBR031	Transfer Station	1993	Bedford
BFI Roanoke Valley Materials Recovery Facility	PBR105	Materials Recovery Facility	1995	Roanoke
Blue Ridge Disposal Inc	PBR104	Materials Recovery Facility	1996	Montgomery
Botetourt County Sanitary Landfill	582	Sanitary Landfill	1994	Botetourt
City of Bedford (Hylton Site)	569	Sanitary Landfill	1993	Bedford City
City of Salem Transfer Station	PBR028	Transfer Station	1993	Salem
Country South	581	C/D/D Landfill	1994	Roanoke
Environmental Options, Inc. Transfer Station	PBR153	Transfer Station	1999	Franklin
Floyd County SW Transfer Station	PBR050	Transfer Station	1993	Floyd
Franklin County Sanitary Landfill	072	Sanitary Landfill	1973	Franklin
Garner Tire Comp. MRF	PBR127	Materials Recovery Facility	1997	Roanoke
Georgia Pacific Corp.	PBR036	Incineration/Energy Recovery Facility	1993	Bedford
LCM Transfer Station	PBR136	Transfer Station	1998	Roanoke
Martinsville Sanitary Landfill	049	Sanitary Landfill	1972	Martinsville
Montgomery Regional Solid Waste Authority Transfer ST	PBR149	Transfer Station	1998	Montgomery
Montgomery RSWA Tire Storage Facility	PBR169	Materials Recovery Facility	NA	Montgomery
Patrick County Solid Waste Transfer Station	PBR032	Transfer Station	1993	Patrick
Roanoke Cement Landfill	514	Captive Industrial Landfill	1987	Botetourt
Roanoke Transfer Station	546	Transfer Station	1992	Roanoke
Roanoke Valley Medical Clinic, Inc.	PBR374	RMW Storage Only	NA	Roanoke
Shredded Products Corp. Landfill	552	Captive Industrial Landfill	1992	Franklin
Smith Gap Regional Sanitary Landfill	555	Sanitary Landfill	1992	Roanoke
Thomas Brothers Debris Landfill	445	C/D/D Landfill	1984	Roanoke

Solid Waste Facilities in Watershed Counties - VADEQ West Central Regional Office				
Facility Name	**Permit Number**	**Facility Type**	**Year Permitted**	**County**
VA Health Care Waste Mgmt. Corp	PBR087	RMW Storage Only	1994	Roanoke
Virginia Health Care Waste Transportation, Inc.	PBR143	RMW Storage Only	1998	Roanoke City
VPI Pathological Incinerator	185	RMW Incineration	1975	Montgomery

5.4 Toxic Substance Control Act

Congress enacted the Toxic Substances Control Act (TSCA) of 1976 to give EPA the ability to track the 75,000 industrial chemicals currently produced or imported into the United States, including PCBs (http://www.epa.gov/region5/defs/html/tsca.htm). EPA repeatedly screens these chemicals and can require reporting or testing of those that may pose an environmental or human-health hazard. EPA can also ban the manufacture and import of those chemicals that pose an unreasonable risk (15 U.S.C. §§2601 et seq.[1976]). Additionally, mechanisms are in place to track the thousands of new chemicals with unknown or dangerous characteristics that industries develop each year. TSCA supplements other federal statutes, including the Clean Air Act and the Emergency Planning and Community Right-to-know Act (Toxic Release Inventory). Additional information on these programs is available from the USEPA, including the EPA web pages (http://www.epa.gov/region3/defs/html/tsca.htm).

The Toxic Release Inventory (TRI) database was reviewed to identify potential PCB sources in the Roanoke River Basin. There are currently no facilities in the watershed that use or manufacture PCBs.

5.5 Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) provides a federal "Superfund" to clean up uncontrolled or abandoned hazardous waste sites, as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment (http://www.epa.gov/superfund/sites/npl/npl.htm). Through the act, EPA was given power to seek out those parties responsible for any release and ensure their cooperation in the cleanup.

EPA cleans up orphan sites when potentially responsible parties cannot be identified or located or when they fail to act. EPA obtains private party cleanup through various enforcement tools such as court orders, consent decrees, and other small party settlements. EPA also recovers costs from financially viable individuals and companies once a response action has been completed. After a site investigation shows no pollutants or shows that remediation standards have been met, the site is deleted from the active list and is placed on a list for No Further Remedial Action Planned (NFRAP).
EPA is authorized to implement CERCLA in all 50 states and the U.S. territories. Superfund site identification, monitoring, and response activities in states are coordinated through the state environmental protection or waste management agencies (42 U.S.C. §§ 6901 et seq. [1976]).

Tetra Tech personnel searched the CERCLIS database (CERCLA Information System) for sites located within the Roanoke River Basin. A total of 29 sites were identified in Roanoke City, Salem, Bedford, Bedford City, Danville, Danville City, Campbell, Henry, Martinsville City, Pittsylvania, Botetourt, and Patrick counties (Table 5.6). Further investigation is required to verify whether any of these facilities potentially contribute PCBs to the watershed.

Table 5.6 CERCLIS sites located in Roanoke River Basin counties

Site Name	Permit ID	County

Cycle Systems	VA0000801050	Roanoke City
American Viscose Co.	VAD980927032	Roanoke City
Dixie Caverns County Landfill	VAD980552095	Roanoke City
Eastern Developers	VAD980552335	Roanoke City
Evans Chemical Site	VASFN0305570	Roanoke City
Matthews Electroplating	VAD980712970	Roanoke City
Roanoke River Flood Control	VA0000103457	Roanoke City
Starlight Lane Tire Fire	VAN000305871	Roanoke City
Hutchins, LE	VAD988207098	Salem
Old Salem Tannery	VAD988170437	Salem
Salem Hardware Fire	VAN000305989	Salem
Marine Salvage Yard	VAN000305986	Bedford
Closed Bedford Co. Landfill	VASFN0305455	Bedford City
PFS Ammonia Release	VASFN0305449	Bedford City
Baldwin Street PCB Drum Site	VA0001995349	Danville City
Disston Lagoon	VAD980705362	Danville City
Paul's Automotive Products	VAN000305919	Danville City
Brookneal Highway Chemical	VAN000305646	Campbell
Piedmont Homes Site	VA0002269900	Henry
Specialty Coatings	VAN000305667	Henry
Doylewood Treating Site	VA0000094490	Martinsville City
First Piedmont Corp Rock Quarry	VAD980554984	Pittsylvania
First Piedmont Landfill	VAD055043020	Danville
Old Richmond Road TCE Site	VAN000305665	Danville City
Sycamore Well Site	VASFN0305541	Danville City
Blue Ridge Drum Dump Assessment	VAN000305653	Botetourt
Hutchins, LE-Stuart	VAD988207106	Patrick
Marsteller Site	VA0001011501	Roanoke City
Lester- Penn Oil Spill	VA0001185794	Martinsville

5.6 Superfund Sites

Of the 29 CERCLA sites identified in the Roanoke River Basin, three were included on the National Priorities List as of March 2003: First Piedmont Rock Quarry, Dixie Caverns County Landfill, and Matthews Electroplating. Of these, Dixie Caverns County Landfill has been identified as a potential source of PCBs to the Roanoke watershed based information contained in the Superfund Fact Sheet for this facility and its location at the headwater of a PCB impaired segment.

Roanoke County, Virginia operated Dixie Caverns County Landfill as a disposal site for municipal refuse, solvents, and fly ash from 1965 to 1976. From 1967 to 1975, electric arc furnace air emission control dust from the Roanoke Electric Steel Corporation was taken to the site and disposed in a fly ash pile. When the landfill was closed in 1976, it was not capped. An intermittent stream on the site flowed through a large drum pile and the fly ash pile, and emptied into the Roanoke River approximately two miles southeast of the landfill. There was also a sludge disposal pit on site.

In the fall of 1987, the County of Roanoke entered a Consent Agreement and Order with the Environmental Protection Agency (EPA) that required the county to clean the site. The site was placed on the National Priorities List (NPL) in October 1989. Negotiations for the Remedial Design/Remedial

Action (RD/RA) Consent Decree concluded in June 1993. The County of Roanoke and Roanoke Electric Steel Corporation agreed to clean up the fly ash pile, reimburse EPA more than $1.27 million in past response costs, and pay all future costs associated with the cleanup.

There were four areas of the site that required remediation: the drum disposal area, the solvent contaminated sludge pit, the fly ash disposal area (ash from the electric arc furnace), and the stream area. A removal action was performed in 1988 to dispose of drums and contaminated sludge from the sludge pit.

The Operable Unit 1 (OU-1) Record of Decision (ROD) addressing the fly ash was signed in September 1991. High temperature metals recovery of lead and zinc was the chosen remedy. Remedial action began in August 1994 and was completed in August 1995. On August 30, 1995, EPA and the State conducted a final inspection of the removal and OU-1 remedial actions. There was no operation and maintenance phase for this OU.

OU-2 covered the remainder of the site. After a Removal Order addressing stream sediments was signed in August 1992, EPA issued a no further action ROD for OU-2, based on the rationale that all risks posed by the remainder of the site had been or were to be addressed under prior and current remedial and removal actions. The removal action to extract ash sediment from the stream and encapsulate it on site began in 1995, and was completed in 1997. Stream restoration completed in the summer of 1997 was the last major remedial activity on the site. Monitoring well abandonment, detention pond clean out, and landfill capping were completed by the fall of 1997. The first Five Year Review for the site was completed in the summer of 2001.

The on-site sludge pit soil was contaminated primarily with aromatic and polycyclic aromatic hydrocarbons (PAHs). Also, the drum disposal area was contaminated with organic chemicals. In addition, runoff water from the fly ash pile contaminated stream sediments immediately downstream of the site with ash and metals. Prior to the cleanup completed in 1997, conditions at the site were a threat to surface waters in the area; however, residential wells that were tested did not show site contamination.

The site was delisted from the National Priorities List in September 2001. The next Five Year Review will be completed in 2006 to ensure that the remedy is protective and functioning properly. Community Relations and Concerns. EPA scheduled a final on-site public review of the remediated site for the fall of 1997. The intent of the meeting was to show the completed work and answer questions and concerns. When the Potentially Responsible Parties (PRP) (Roanoke Steel Company and Roanoke County) declined to participate in the public meeting, EPA canceled the function.

5.7 Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act of 1976 (RCRA) gave EPA the authority to control hazardous waste "cradle to grave" (http://www.epa.gov/region5/defs/html/rcra.htm). This control includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also sets forth a framework for the management of nonhazardous waste. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. RCRA focuses only on active and future facilities and does not address abandoned or historical sites. According to the EPA RCRA Information System (RCRIS) records, the Roanoke watershed contains a number of RCRA sites that are currently under review. Additional information on RCRA sites will be collected in collaboration with DEQ personnel.

6. Additional Data Needs

Additional data collection is needed to further define the spatial extent of PCB contamination, identify PCB "hot spots" and potential sources in the watershed, and to provide supplemental data required for modeling and TMDL development. The area below Altavista has been extensively monitored by DEQ through targeted special studies. BGF Industries was identified as a source of PCB contamination in the Staunton (Roanoke) River through this effort. Other areas along the Roanoke River have been found to have high PCB concentrations in recent years. These areas, especially the upper portion of the Roanoke River, will require additional sampling in order to identify contributing sources of PCBs.

A sampling plan to facilitate the development of PCB TMDLs for the Roanoke River will be developed over the next few months. The scope of the sampling plan will depend on the availability of resources and discussions with EPA and DEQ on monitoring priorities. Sediment sampling and the use of semi-permeable membrane devices (SPMDs) will be used to identify areas with high PCB concentrations. Additional data needs may include supplemental water quality information and other data required for model setup and calibration. Source identification efforts will also continue through the examination of pollution complaint records and other relevant information maintained by DEQ. Information collected from stakeholders in the watershed will be used to help identify priority sampling areas and potential PCB sources.